### The Nordenfelt Submarine Boat.

The interest excited by the recent trials of the Nordenfelt submarine boat is sufficiently shown by the presence at Landskrona of 39 officers representing every European power, together with Brazil and Japan. Such a boat, if successful, will exercise a powerful influence both on naval warfare and on coast defence. Its possible uses are manifold, its moral effects unquestionable. Against its operations no system of defence at present suggested seems adequate. The introduction of fast torpedo boats has supplied a new factor in warfare and, *pace* Hobart Pasha, their influence will some day make itself powerfully felt. But the torpedo boat has been met actively by the machine gun, capable of delivering an extremely rapid fire of small shell at ranges far beyond the useful limit of the Whitehead, and passively by the steel wire netting with which it is proposed to surround ships. Again, the torpedo boat can be met and fought on the sea by similar boats, faster, better handled, or better armed. On the other hand, a boat which can maintain a fair speed under water for several hours, which need only to rise to the surface for brief periods, and can sink at will if discovered, which can lie *perdu* and direct a steered torpedo, or run up to close quarters and fire the Whitehead at 10 feet below the surface is, undoubtedly, an exceptionally dangerous antagonist. If the problem of producing such a boat can be solved, the largest ship would be secure only when in rapid motion, no port could be satisfactorily defended, and no system of submarine mines could be regarded as safe. Mr. Nordenfelt has addressed himself to the solution with a measure of success which will be discussed later.

It is no new problem. Submarine boats were employed in the American war, where some successes were claimed for them; and considering the enormous advantages to be obtained, it is not surprising that at least one European power has devoted both time and money to experiment. But there has been a natural tendency to preserve secrecy on the subject—since to create the vague suspicion of the possession of a submarine boat would be a more desirable object than to proclaim the existence of one with known imperfections and limitations. Besides, the past record of the performances of these boats has not been free from disaster. Several have sunk with their crews to rise no more; others have remained fixed and helpless at the bottom for long periods, to be saved only by exceptional coolness and exertion on the part of the crews. It would be clearly unwise to create an antecedent impression of the exceptional danger involved in their service at a time when such danger might be due chiefly to structural imperfection and want of knowledge. For the problem is no easy one when its conditions come to be realized. Power to sink and rise rapidly at will, fair speed under water, horizontal and vertical steering power under full control, endurance of motive force, and air supply for the crew, are only some of the many requirements on the fulfilment of which success is dependent.

The Nordenfelt boat, the first of its class, was built at Stockholm about two years ago. The boat is cigar-shaped, with a coffin-like projection on the top amidships, formed by vertical combings supporting a glass dome, or conning tower, 1 feet high, which enables the commander to see his way. The dome, with its iron protecting cover, stands on a horizontal lid, which can be swung aside to allow the crew of three men to get in or out without difficulty. The length of the hull is 64 feet, and central diameter 9 feet.

It is built of Swedish mild steel plates ⅝ inch thick at the centre tapered to ⅜ inch at he ends, supported on angle-iron framing, 3 inch by 3 inch by ⅜ inch. The arrangements for sinking the boat are of a special nature, for which the inventor claims important advantages. Practically, such a boat can be sunk in three ways, singly or taken in combination. It may be forced down by power applied from within, weighted down by taking in sea water sufficient to destroy the buoyancy, or it may be steered down by the application of its ordinary motive power modified by a horizontal rudder. Mr. Nordenfelt has adopted the former arrangement, placing sponsons on each side of the boat amidships in which are wells for the vertical propellers capable of working the boat up or down. In order to prepare for action, enough sea water is taken in to reduce the buoyancy to 1 cwt., which suffices to keep the conning tower well above the surface. In order to sink the boat further the vertical propellers are set in motion, and, by their action, it is held at the required depth. Thus, to come to the surface again, it is merely necessary to stop the vertical propellers, in which case the reserve of buoyancy at once comes into play. The principle is rightly regarded as important, even if not essential, in a safe submarine boat. A breakdown in the engines does not entail danger, since the reserve of buoyancy is never lost for a moment. As a still further safeguard, however, Mr. Nordenfelt has provided an automatic check on the downward motion. A lever, with a weight which can be adjusted so as to counterbalance any desired head of water, is connected with a throttle valve supplying steam to the engine working the verticle propellers. Thus, directly the desired depth is exceeded, the increased head of outside water overcomes the weight, and the vertical propellers are stopped.

The motive power is steam alone, generated in a boiler of the ordinary marine type with a forced draught. So long as the boat runs on the surface, this boiler can be stoked and a constant head of steam maintained. The smoke is driven out through two channels which pass partly round the hull and point aft. For submarine work, no stoking is, of course, possible, and the firebox has to be sealed. It is therefore necessary to store the requisite power beforehand, and this is done by heating the water in two tanks placed fore and aft and connected by circulating tubes with the boiler, till a pressure of about 150 lb. per square inch is attained. With about this initial pressure, it is stated that the boat has been driven for 16 miles at a speed of three knots. The greatest surface speed attained is a little over eight knots, and the boat has been run for 150 miles without recoaling. There are three sets of engines, one of which drives the propeller, an ordinary four-bladed screw 5 feet in diameter, with a pitch of 7 feet 6 inches. The other engines drive the blower and the horizontal propellers respectively.

One of the principal difficulties of submarine navigation is to preserve an even keel when under water. Should a boat turn downwards when in motion below the surface, it might easily strike the bottom or reach a depth at which it must collapse before its course could be arrested. On the other hand, if the bow took an upward turn, under the same circumstances, the boat would rapidly come to the surface and be exposed to view and to projectiles. It is evidently, therefore, of the utmost importance to provide ample steering power in a vertical direction. In the Nordenfelt boat, two horizontal rudders are placed one on each side near the bows, and are acted upon by a pendulum inside the hull. This pendulum coming into play the instant the boat takes a cant in either direction, actuates the horizontal rudders, and causes her immediately to return to an even keel. By this means, it is claimed that the boat is automatically kept with her axis horizontal, while since the bow rudders are entierly beyond the control of the crew, there is no danger of accident due to neglect of loss of nerve. In the event of a breakdown of the above arrangement, it is necessary at once to stop the boat and let her return to the surface. No compressed air is carried, and the crew depend, therefore, for existence on the amount of air sealed up in the hull. With this amount of air only, four men have remained for a period of six hours without any special inconvenience. The above are the main features of the invention which Mr. Nordenfelt has just made public, and which has received the careful consideration of experts of many nations. In a subsequent article it is proposed to discuss the results obtained in the recent experiments as well as the measure of promise those results afford.—*London Times.*

A NEW PAVING MATERIAL.—European cities are taking up cobble stones and putting down cedar-blocks pavements, while in this country cedar blocks are being replaced by granite and cobble stone, indicating that nothing definite has been arrived at, concerning the best material for paving. In Chicago a company has been formed with a capital stock of $250,000 for the manufacture of a pavement constructed of iron and tempered asphaltum, which is said to last longer than either granite, cobble stone or wood blocks, causing less noise, and at about the same cost as granite. It has been tried in that city, thirty yards of it having been laid some time ago on Clark street, near the county building, and has, it is said, given entire satisfaction. The incorporators of the company are Charles Peck, Horace W. Walters, Charles H. Kirkham, and Homer N. Hibbard, with office at No. 9 Wabash avenue, Chicago, Ill.

## NEW ORDNANCE MATERIAL*

Official Report to the U. S. War Department of

WM. H. BIXBY, CAPT. OF ENG'S., U. S. ARMY.

### Gun Carriages Allowing no Recoil.

*Krupp's Non-Recoiling Muzzle-Pivoted Gun* — The most successful non-recoil gun so far constructed, is the Krupp non-recoiling muzzle-pivoted and combined-gun-and-casemate gun (Panzer-kanone) variously called also "muzzle-pivoting gun," "no-recoil gun," "iron-fort and gun," "shield-gun" and "gun-casemate gun."

The construction and trials of this gun were studied by the writer in 1881. Both are given in detail below †for the reason that the gun is a remarkable gun and one that, according to all so far published French, German, and English descriptions, is capable of rendering valuable service; moreover no single article yet published contains a full description and history of the gun and its trials.

*Introduction.*—The gun-casemate gun (Fr. *canon a cuirasse* or *canon cuirasse*) (German *Panzer-kanone*) is the result of experiments commenced by Mr. Krupp in 1876, and continued up to the present date.

The object of Mr. Krupp was to show "that it was possible to construct, for the defence of military places, a casemate structure such that the accuracy of the fire and the power of the enemy's guns should be without effect upon such place; while at the same time the guns of the defence protected by the casemate might keep up a destructive fire upon the besiegers.

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†The greater part of this report, especially as to the trials, is taken from the reports and articles of Maj. Geldern-Egmond and Count d'Ursel as quoted under "Bibliography;" modified by the information gained by a personal visit to the works of Mr. Krupp at Essen, in 1881. With but a few exceptions, it is the same as that submitted to the Chief of Engineers, U. S. Army, by the writer in November, 1881.

Plate 1, also Plate 2, Fig. 3, are taken from the article by Major Geldern; Plate 2, Figs. 1 to 7, and Plate 3, are taken from that of Lieut. Ursel; Plate 4 is from the Mitth. d'Art. und Gen. Wesens, for 1879.

The gun-casemate gun consists essentially of a gun firmly connected, by a ball-and-socket joint at its muzzle, to the front plate of an iron casemate; the latter being so heavy and so solidly placed in position, as to prevent any perceptible recoil in the combined casemate and gun when the gun is fired.

The advantages of the new gun are:—The complete protection of its cannoniers, and great rapidity combined with accuracy of fire.

Mr. Krupp has applied this system successively to an 8.0-c. m. (3.2-inch) gun, tried in September, 1876, at Bredelar, Germany; to a 14. 9-c. m. (5.9-inch) gun (see plate 3,) tried at Bredelar, October and November, 1877; and to a 15.5-c. m. (6.10-inch) gun (see plate 4), tried at Bredelar, June, 1878 and August, 1879. Since then he has exhibited nothing new, but has continued to study out improvements which may remedy any defects in the past models.

Basing their ideas upon these improvements the Austrian Government give[1] an adaptation of this gun to the 20.9-c.m. (8.23-inch) gun, but no such gun has as yet been actually constructed.

*General Features.*—The principal parts of the gun and casemate are shown in the accompanying sketch, (Plate 1) representing a vertical section through the axis of the gun.

In this sketch,

A is the gun proper,
BB is the "ball-head;"
CC is the "socket-piece," connecting BB to DD;
DD is the "front-plate" of the casemate;
E is the "substructure" of the casemate;
F is a movable shutter, or exterior "mantelet" to cover the mouth of the gun, when not firing.
G is an earthern glacis;
H is the glacis interior wall;
I is the roof of the casemate;
K is an earthern roof-covering.

The gun rests, in its rear, on a suitable carriage allowing the gun to be properly and conveniently manoeuvred, by hand, by four men.

*Details.*—The different parts of the gun-casemate gun will be described in detail in the order as above mentioned.

*Gun.*—The gun is a breech-loader of the usual Krupp construction, of Krupp steel, from 20 to 25 calibers long, and hooped throughout its entire length.

The 8.0-c.m. (3.2-inch) gun fired a 6.8 kilogram (15.0 pound) projectile, with 1.5 kilograms (3.3 pounds) of powder.

The 14.9-c.m. (5.9 inch) gun was of 3,600 kilograms (3.6 tons) weight; it fired sand-loaded shells of 29.7 kilograms (65.3 pounds) and solid cast shells of 40.5 kilograms (89.1 pounds) weight, with 6,5 kilŏgrams (14.3 pounds) of prismatic powder.

The 15.5-c. m. (6.1-inch) gun was of 3,592 kilograms (3.6 tons) weight with a rifled chamber, a rifled bore, 36 grooves, and a uniform twist of 1 turn in 45 calibers length, 39.5 kilograms, (8.71 pounds) weight, with 6.5 kilograms, (14.3 pounds of 7-channeled prismatic powder; its projectiles were circled with two copper rings. It has been fired 291 times with shells and full charge.

In the 1879 trials, the casemate was provided for sighting, with a peep-hole cut through the front plate above the mouth of the gun.

In all the experiments hereafter spoken of, the pieces firing both from and against the casement were always fired with their maximum charges.

*Ball-head.*—The ball-head is of steely iron, and is firmly attached by its interior screw surface to the exterior surface of the front end of the gun's inner coil.

This attachment seems to have been a success; 213 shots from the 8-c. m. (3.3-inch) gun (September, 1876), and 130 shots from the 15.5-c. m. (6.1-inch) gun (June, 1878), and 342 shots with shells and full charges (August, 1879), do not appear to have produced any sensible deterioration of this attachment.

The exterior surface of the ball-head is perfectly spherical; it fits exactly into a corresponding socket surface, half in the front plate of the casement in front, and half in the socket piece in rear.

As long as the mouth of the gun is protected by the mantelet from direct fire, and as long as the socket piece can be unscrewed, the ball-head serves its purpose successfully, as shown by experiments of November, 1877, with the 14. 9-c.m. (5.9-inch) gun. (See "Socket-piece" below.)

If, however, the mantelet being dropped, several shots strike too close to the embrasure, the front half of the socket surface is liable to be deformed; then, unless the socket piece can be partially unscrewed, the friction between the latter and the ball-head will be so great as to prevent any further movement of the gun. Such deformation of the embrasure surroundings was actually produced, (as will be explained under the heading, "socket piece,") in the experiments of November, 1877. Such an accident, however, militates against the construction of the socket-piece, and not against that of the ball-head, since, the partial withdrawal of the socket-piece will allow the ball-joint to function satisfactorily enough. If, the mantelet being dropped, any shot strike the ball-head, there is great danger of the gun being rendered unserviceable; such accident is liable to happen to the chase of all guns, of no matter of what system, and can not be prevented during the act of firing. If, however, the socket-piece can be removed, another gun can readily be put in the place of the one already damaged, and the fire can then be resumed. In any case, the damage to the gun and cannoniers is no greater than results under similar circumstances to guns of any other system.

The ball-head and the metal of which it has been composed, have stood very fairly the several tests to which they were subjected in the experiments at Bredelar.

The ball-head worked perfectly, without suffering the least disorder, either from the repeated discharge of its own guns or from the projectiles fired against it, as long as the mantelet remained unbroken in its raised position.

In the experiments of November 8, 1877, the mantelet was removed from in front of the embrasure, and three chilled shell were fired with maximum charges, from a 14. 9-c.m. (5.9-inch) Krupp gun at 340 meters, (1,115') distance, and struck inside the embrasure; the first two hit fairly the exposed surface of the ball-head without producing any great damage; the third succeeded in penetrating between the ball-head and the concave surface of the socket, broke the ball in two, and allowed the gun and carriage inside the casement to fall down.

(Plate 2 gives the hits obtained, in the order of their firing, and shows the general appearance of the front plate after the firing was ended.)

The chilled 12-c. m. (4.7-inch) shell, weighed 19 kilograms, (41.8 pounds), and were fired with a 3. 2 kilogram (7.4 pounds) cartridge; the 15-c. m. (5.9-inch) shell weighed 39.5 kilograms (86.9 pounds) and were fired with a 6.5 kilogram (14.3 pounds) cartridge. The percussion exploding 12-c. m. shell weighed 16.2 kilograms, (25.6 pounds); and the 15-c.m. shell 3.13 kilograms, (68.8 pounds), they used the same cartridges as the chilled shell.

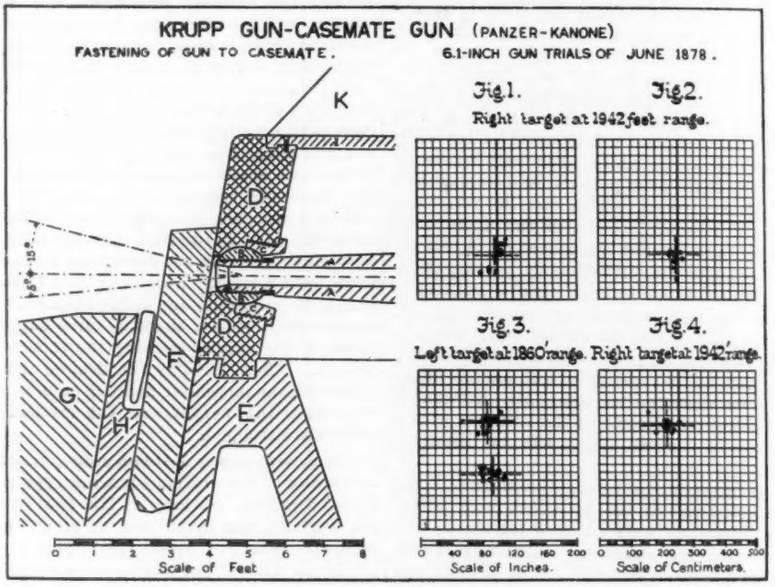


Plate. No. 1.

*Socket-Piece.*—The socket-piece is of forged iron, and is attached to the front plate in the casemate, by its exterior surface. This exterior surface is cylindrical, and carries a screw-thread fitting a corresponding surface in the front plate; the interior surface of the socket-piece is half spherical, half conical, the former to fit accurately against the rear of the articulation sphere, the latter opposite the chase of the gun, to permit a sufficient field of fire to the gun.

The 14.9-c. m. (5.9-inch) gun had a horizontal field of fire of 45 degrees, and permitted 15 degrees elevation, and 5 degrees depression.

It is evident that the socket-piece must be as firmly attached to the front plate, as the bald-head is to the gun. Moreover, the socket-piece must be capable of being readily and easily screwed in or out of the front plate, in order to give to the ball-head its proper bearings in its socket, and to permit the entire withdrawal of the gun if necessary.

The socket seems to have fulfilled very well all of these requirements. With the 8.0-c.m. (3.2-inch) gun after the discharge of 213 shots, with 1.5. kilograms (3.3. pounds) of powder, and 6.8. kilograms (14.9 pounds) projectiles, (60 of the shots having been fired in 15 minutes) the socket piece was readily unscrewed from the front plate.

With the 15. 5-c. m. (6. 0-inch) gun, after the discharge of 120 shots, with 6.5. kilograms (14.8 pounds) prismatic powder, and 35.5 kilograms (78.1 pounds) projectiles, the socket piece appeared to be in perfect order.

With the 14. 9-c. m. (5.9-inch) gun. the embra-

[1] See plates 6, 7, and 8 of the "Eisen-Panzer Constructions," Vol. 2 of Construction Details."

sure being covered by the exterior mantelet, the front plate received (30th October, 1877) 3 percussion-fuse exploding shells fired with maximum charge from a Crupp 12- c. m. (4.7-inch) gun at 220 meters (722′); then from the same gun at the same distance and with maximum charge 2 chilled sand-filled shells; then from the 15-c. m. [3] (5.9-inch) at 340 meters (1.115′) with maximum charge, one chilled sand-filled shell; and finally (7th November, 1877) from the 12-c. m. (4.7-inch) gun at 220 meters (722′), 5 more sand-filled chilled shells.

After the reception of all these shots by the front plate, and one other by the mantelet, neither the socket-piece nor the ball-head seemed to be in the slightest degree deranged; and the mantelet being dropped, 10 shots were fired from the 14.9-c. m. (5.9-inch) gun casemate gun with remarkable precision.

Eleven more percussion-fuse exploding shells were fired into the front plate, from a 15-c. m. (5.9-inch) Krupp gun at 340 meters (1.115′) distance with maximum charge; then from the same gun at the same distance and with the maximum charge, 3 sand-filled chilled shell were fired into the front plate and one into the mantelet. Still no damage to the socket piece nor ball-head.

Next, (8th November, 1877) six shots were interchanged by 14. 9-c. m. (5. 9-inch) gun-casemate gun, and the 15-c. m. (5. 9-inch) gun; the mantelet being raised before each shot which came from outside against the casemate. Still no damage was done to the socket piece nor to the ball-head, and the gun-casemate gun continued to fire with its usual accuracy and rapidity, According to Krupp, in his report of August 8th, 1879[3]: the socket piece was unscrewed, the gun taken to the rear, and the ball-head unscrewed, all in 35 minutes; (the number of men employed is not stated). Then a new ball-head was put on, the gun was moved forward, and socket pin screwed to front plate; this work occupied in all 40 minutes. Some care was necessary in getting the first thread of the socket piece to start on rightly. After that there was no further delay. When the ball-head and socket piece were apparently in place, a small charge was fired to see if all was right. Next, two full charges were fired with results which showed everything to be all right, At the request of some officers, the socket piece was unscrewed a half turn, so that the ball-head was no longer in forcible contact with the socket-piece; two full charges were then fired; and no trouble was caused thereby.

These experiments show conclusively that, as long as the mantelet remains in place the socket piece and ball-head answer perfectly their requirements; not so, however, when the mantelet is dropped and the embrasure uncovered.

The 8th November, 1877, the mantelet being lowered so as to expose the embrasure, nine 12-c. m. (4.7-inch) percussion-fuse exploding shells were fired into the front plate from a distance of 220 meters (722′); 5 striking above, 4 below, and all close to the embrasure upon parts ordinarily covered by the mantelet these shots, without breaking the front plate nor penetrating more than 25-c. m. (9. 8 in.), deformed the metal near the embrasure to such extent that the ball-head and socket piece were firmly clasped in place by friction or undue pressure, and it was found impossible to unscrew the socket piece. At the end of about an hour, by the use of powerful jacks, the gun was again set free, but its accuracy of fire was totally lost; 3 shots, fired at 550 meters (1,804 ft.) range, missed the target completely. In order to have rendered the casemate available for further action, it would have been necessary (as the socket piece could not be unscrewed) either to have cut out the gun and socket piece, or to have replaced both gun and front plate. Either process would require a long time in action.

In the Krupp models, prior to 1879, the socket piece was made of a single piece of forged iron, and was of about 60-c.m. (25.2 in.) exterior diameter throughout its whole length.

In his report of August, 1879, Krupp proposed to make the socket of three pieces all of different diameters; the largest piece, the one nearest the inside of the casement, was 1.00 meter (39.4″) in exterior diameter, and carried square screw-threads on its exterior; and carried also cog-teeth on its inner side next the interior of the casement to facilitate its being screwed in and out.

It will doubtless be found possible to increase the exterior diameter of this socket piece, and to diminish the thickness in such proportions as, while preserving to the socket piece its requisite strength and stiffness, will still allow of its being unscrewed or removed in case of accident.

*Front Plate.*—The front plate of the casemate has, up to the present moment, been constructed of forged wrought-iron.

For the 14.9-c.m. (5.9-inch) gun, it was trapezoidal in shape 1.60 meters (5.25 ft.) wide at the top, 1.10 meters (3.61 ft.) wide at the bottom, approximately 1.75 meters (5.74 ft.) high, and 0.50 meters (20.0 in.) thick; it weighed about 8,000 kilograms (8 tons).

Its front inclined upward toward the rear at an angle of about 10 degrees with the vertical. This plate, the only part of the casemate exposed to the attacking fire, was supported in rear by wrought-iron tubular counter-braces, and rested upon a base of cast-iron to which it was attached by a dove-tailed joint tightened up by wooden wedges.

The plate was evidently a complete protection to the cannoniers. It received (November 1877), see Plate 2) 35 hits; 19 of them from the 12-c.m. (4.7-inch) Krupp gun, at 220 meters (722′), and 16 from the 15-c.m. (5.9-inch) Krupp gun, at 340 meters (1,115 ft.); it was not broken by these shots, and not one of all of these projectiles had penetrated it to more than 25-c.m. (9-8 in.) depth.

In several cases it happened that the hole, made by one shot, was partially closed by the succeeding one.

I was told that Mr. Krupp, not satisfied with the conduct of the front plate near the edges of the embrasure at the joints usually covered by the mantelet, has in his recent modifications hardened the metal and increased its thickness near the embrasure, so that shots, striking outside of the embrasure but near to it, will no longer produce any sensible deformation at the socket's bearing surfaces. In his report of 1879, he also proposes to thicken the whole front plate.

The Austrian models (see "Constructions-Details") provide for the use of an exterior shield attached to the front plate by bolts, with conical heads on the exterior, and keys upon the interior; it remains yet to be seen by actual trial, whether this construction guarantees the requisite protection to the plate outside together with the requisite safety to the cannoniers inside.

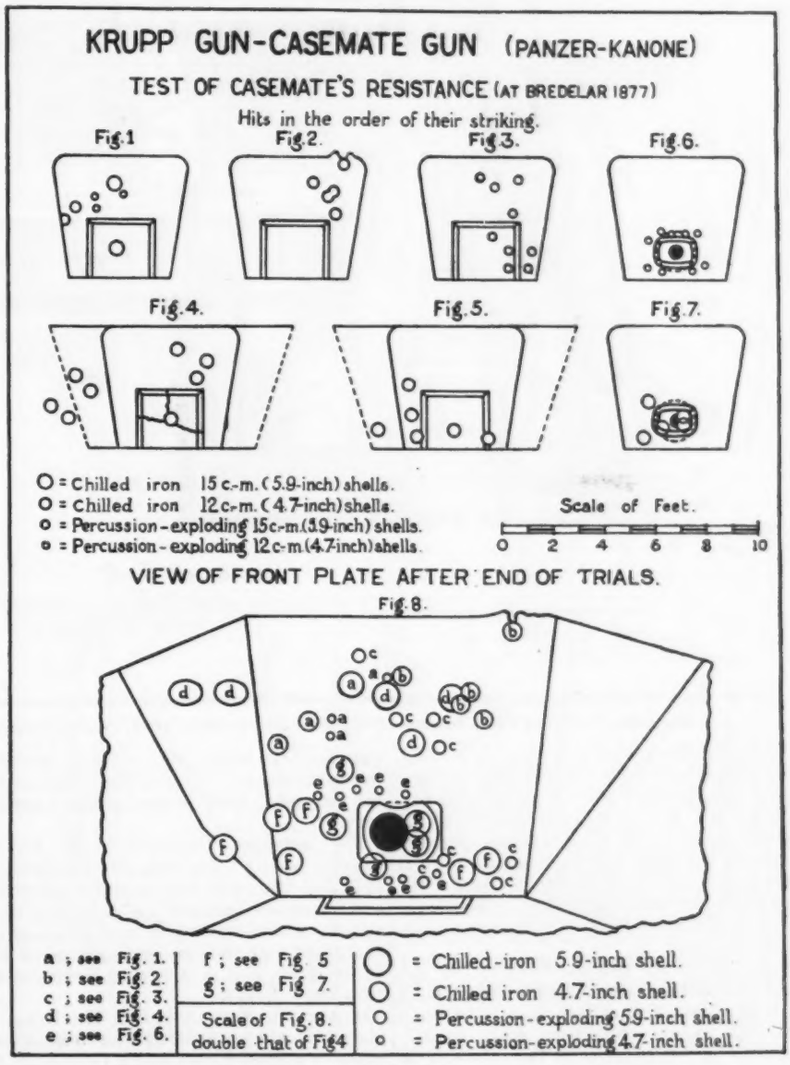
KRUPP GUN-CASEMATE GUN (PANZER-KANONE)
TEST OF CASEMATE'S RESISTANCE (AT BREDELAR 1877)
Hits in the order of their striking.
Fig.1
Fig.2.
Fig.3.
Fig.6.
Fig.4.
Fig.5.
Fig.7.
O = Chilled iron 15 c-m. (5.9-inch) shells.
O = Chilled iron 12 c-m. (4.7-inch) shells.
o = Percussion-exploding 15 c-m. (5.9-inch) shells.
o = Percussion-exploding 12 c-m. (4.7-inch) shells.
Scale of Feet.
0 2 4 6 8 10
VIEW OF FRONT PLATE AFTER END OF TRIALS.
Fig.8.
a ; see Fig. 1.
b ; see Fig. 2.
c ; see Fig. 3.
d ; see Fig. 4.
e ; see Fig. 6.
f ; see Fig. 5
g ; see Fig 7.
Scale of Fig. 8. double that of Fig4
= Chilled-iron 5.9-inch shell.
= Chilled iron 4.7-inch shell.
= Percussion-exploding 5.9-inch shell.
= Percussion-exploding 4.7-inch shell.

Plate No. 2.

[3] The Krupp, so-called, 15-c. m. gun, has an actual caliber of 14. 9-c. m.: but to distinguish between the gun inside the casement, and the gun at the outside firing stand, the former is always spoken of as the 14. 9-c. m. and the latter as the 15. 0-c. m. gun.

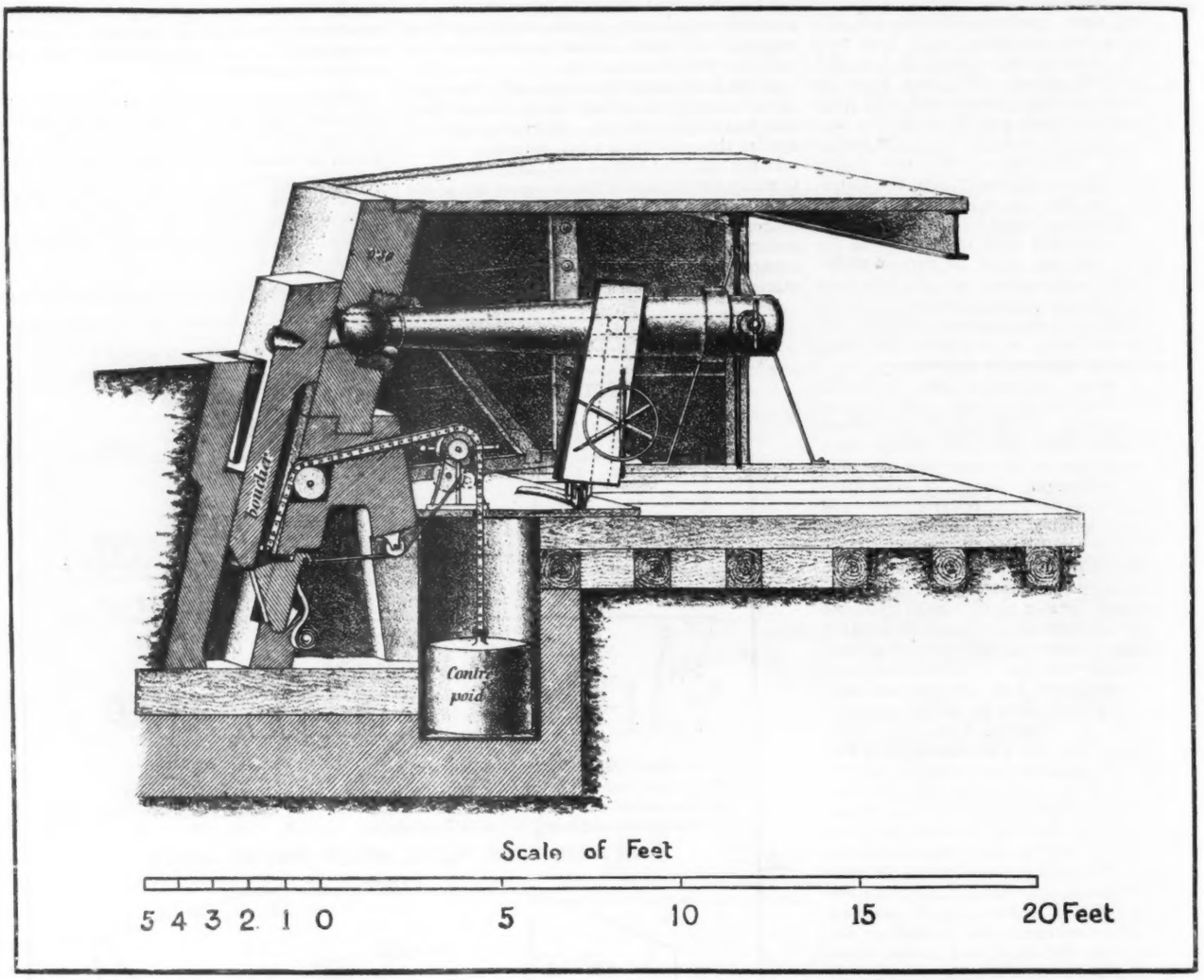


Plate No. 3.—Krupp's Gun-casemate Gun, as used at Bredelar 1877. Vertical section of casemate through axis of Embrasure.

The inclination (10 degrees with the vertical) given to the front surface of the plate, was regarded by almost all the spectators and perhaps by Mr. Krupp, as not favorable to the best resistance of the plate; because thus the surface of the plate was more nearly normal to the trajectory of the projectile than if the front plate had sood vertically. Accordingly in late models (see Plate V,) the front plate stands vertically.

*Substructure.*—As the substructure of the casemate is entirely covered from the enemy's fire, it requires no other care than to be made solid. It has therefore been made by Mr. Krupp, of iron, broader at its base than at its top, and hollow so as to give greater stability for the same weight of metal used.

In the experimental casemate of 1879, the substructure was V-shaped in plan, and of wrought-iron; it descended below the floor of the casemate and was supported on 20-c. m. (8-inch) wooden girders, resting on cement masonry with cut stone binders.

The 1879-80 proposed models show a substructure U-shaped in plan, of cast-iron, descending only to the level of the general flooring of the casemate and resting directly upon brick and masonry foundations. The cast-iron base is made in sections bolted together at its exterior flange; the whole is projected from the enemy's fire by an iron or brick glacis wall, and an earthen glacis.

The only attachment of the front plate to to base of casemate is, as above mentioned, by a dove-tail joint, without bolts, but tightened up by wooden wedges.

*Exterior Mantelet.*—The most difficult question in the construction of the gun-casemate gun, has been to provide a suitable protection to the embrasure; none of the solutions thus far proposed, have proved entirely satisfactory.

The exterior "mantelet" (or movable shutter) used on the 30th October, 1877, was of forged iron, and was partially penetrated and somewhat damaged the only time it was struck, which was by a sand-filled chilled shot, fired with the maximum charge of powder from the 15-c. m.(5. 9-inch) Krupp gun at 340 meters (1.115').

On the 7th November, 1877, Mr. Krupp replaced the old mantelet by a new one of steel; this new mantelet received 3 percussion-fuse exploding shells, fired with maximum charge from the 15-c. m. (5.9-inch) Krupp gun at 340 meters (1.115 ft.) range. The projectiles left but slight traces on the mantelet; a fourth, and chilled shell, from the same gun, broke the mantelet into 3 pieces.

On the 8th November, 1877, the broken steel mantelet was replaced by another of forged wrought-iron; this was touched twice, and struck squarely in its center once, by sand-filled chilled shells from the 15-c. m.(5.9-inch) Krupp gun at 340meters (1.115 ft) range; none of these projectiles, though penetrating to the usual depth, say 15-c. m. (5.9″) did any serious damage to the mantelet, nor prevented its proper working. The mantelet is said to have been 1.25 meters (4.10 ft,) long. 1.25 meters (4.14) wide, and 0.35 meters (13.7 ft) thick.

Later trials of a wrought-iron mantelet inclined to 45 degrees with the horizontal gave more encouraging results, as the shots only gouged out pieces of the mantelet, leaving it still serviceable. Mr. Krupp seems to have favored the use of hard steel for sea fronts, and soft steel or iron for land fronts.

*Mechanism of Mantelet.*—In all the Krupp experiments the mantelet was attached by a chain, passing over pulleys, to a counterpoise within and under the floor of the casemate; in the first model the chain was attached directly to the mantelet by the aid of a pin and screw bolt; in the second model the chain is attached to a support on which rests the mantelet; the support and mantelet being fastened together by a tenon and large single pin joint. In both cases the mantelet was, if anything, heavier than the counterpoise; once raised it rested on a large solid metal catch, held in place by a spring. The servants within the casemate could pull a cord releasing the catch and thus allow the mantelet to drop the instant before the firing of the gun. The mantelet was raised again into place by means of a windlass connected by gearing to the pulley which carried the chain joining the counterpoise to the mantelet. During its motion the mantelet remained parallel to the front of the casemate. This arrangement allowed the mantelet to be dropped quickly, but raised slowly; the actual time necessary to raise the mantelet of the 14.9-c. m. (5.9-inch) gun, (November trials, 1877), was about ten seconds. The mechanism, although somewhat complicated, ought to work well, quickly and efficiciently. There seems to have been no conveniences, however, for replacing a mantelet during the continuance of the enemy's fire.

In the Krupp proposed models of 1879 the

[a] See Krupp reports of experiments of 8th. of August, 879.

counterpoise is heavy enough to hold the mantelet in its raised position. The counterpoise can be raised and the mantelet thus lowered by the aid of a rope passing over a windlass and attached to the counterpoise. This arrangement permits the mantelet to be dropped slowly before firing and to be raised instantly after firing. Moreover the pulleys and connecting chain are replaced by a bent lever with arms of equal length; the counterpoise is attached to one arm, and the mantelet is supported on the other. The mantelet is arranged also to slide down an inclined plane of about 45 degrees declivity; this arrangement favors the stability of the mantelet, and the removal of any material that may fall down between it and the glacis wall, and might allow the replacement of the mantelet during the continuance of the enemy's fire.

*Glacis and Glacis Wall.*—The construction of the casemate's glacis is a matter of minor importance as long as it gives sufficient protection to the base of the casemate and to the machinery of the mantelet, and does not, at the same time, interfere with the movement of the mantelet.

In the Krupp experimental casemate, the beton-glacis was partially supported by thin wrought-iron plates, held up by U or I-shaped wrought-iron struts. A fixed shield of thin iron backed by vertical 10-inch iron frames, surrounded and supported the mantelet, and served as retaining wall for the earth in front, and a loose wedge with a limited amount of motion, was introduced between the fixed shield and the mantelet, so as to press the latter against the front plate of the casemate, and also to prevent extraneous matter from falling between the outside glacis wall and mantelet, and thus interfering with the proper working of the latter.

In the Krupp proposed model of 1879, the use of this loose wedge is obviated by the inclined position of the mantelet and glacis; and the extraneous matter is allowed to fall into a pit constructed in the masonry, and below the iron work.

*Roof Covering.*—The roof covering, not being exposed to direct fire, was in the case of the 14.9-c.m. (5.9 inch) gun, of flat horizontal rolled-iron plates, about 10-c.m. (4.0-inch) thick, covered in the 1877 and 1878 trials with about 75-c.m. (29.5 in.) of earth.

*Side Walls of Casement.*—In the August (1879 trials, the casemate was hexagonal in plan, with a small front, 2 inclined side-walls, 2 rear flanks perpendicular to the front plate, and an open rear parallel also to the front plate (see Plate 4.) The side walls were of wrought-iron, about 9 ft. long, and 9 in. thick; they were so placed with respect to the general line of fire, that any shots striking them would be turned off with but slight damage to either iron or masonry. The small flanks in rear were about 6 feet long, and plated with about 2 inch of wrought iron.

(TO BE CONTINUED.)

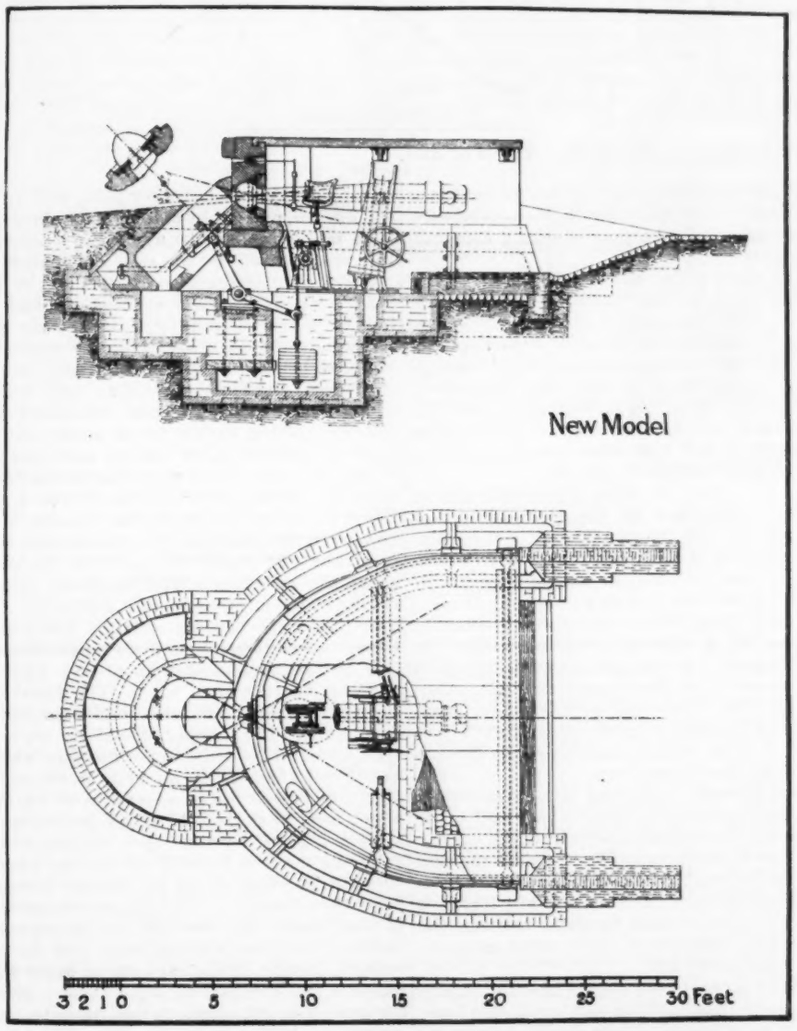


Plate. No. 4.—Krupp's Gun-casemate Gun, as proposed in 1879.

ONE of the attractions of *Cassells Family Magazine* is the department headed "The Gatherer," an illustrated record of invention and discovery, made up of condensed notes written in a way to interest the general reader. Among the notices in the November number are, A Demonstration Microscope, An Electric Plant, A Gigantic Blast, A Balloon Railway, Water Gas, A Speed Indicator, An Iceberg Detector, and several others.

## The Construction of Street Railways in the United States.*

BY WILLIAM WHARTON, JR.

To a considerable extent I have in this paper taken from the report made by me as Chairman of the Committee on Completed Construction of New Road, read before the American Street Railway Association, at their meeting in New York, on October 16, 1884, which was adopted and its conclusions approved by the Association at that time.

In the construction of street railways, there are various matters which influence the details in such a way as to prevent the adoption of all the improvements that would be desirable for the use of the railway cars alone, and in this respect the builders of street railways are at a great disadvantage compared with those who lay down steam railroads, for it is evident that while we must endeavor to get the best roadway for the cars, due regard must be paid to the requirements of general travel along the streets, and to the local laws—often very unreasonable—which govern the form of rail and other details. So that we are not at liberty to use the best means to accomplish the end desired; in fact, the matter is so often hampered with municipal regulations, that it is impossible to accomplish more than an imperfect and unsatisfactory solution of the problem.

The best form of rail for the purposes of the railway company alone, especially where the streets or avenues are wide enough to provide the general travel of the street, with a good and sufficient roadway outside of the space occupied by the railroad tracks, is, undoubtedly, the "center-bearing," as the weight of the car wheel in this case bears directly upon the center of the rail, and is transmitted evenly to the center of the stringer, so that the track is in the best position to resist the outward pressure which is constantly tending to widen its gauge, and otherwise injure its condition. The spikes with this form are placed alternately on either side of the head, so that the rail, besides having a better bearing on the timber, as above stated, is held down equally on both sides. The car wheels run more smoothly and with less friction than upon any other form, as there can be no possible contact with any paving stones, and the open space provided on the outside has a tendency to keep the head of the rail free from dirt and grit. This is especially the case during cold weather, when one of the most serious difficulties in operating street railways arises from frozen mud, ice or snow, getting upon the rails, even when the greatest care is taken to keep the track clear. The center-bearing is the standard street rail now in use in New York City, and it is used to a considerable extent in Brooklyn, and a few other places.

In the next form, known as the "slope-back," the bearing is approximately in the center, the head being about three inches wide and beveled or sloped off on the outer edge, so that to a certain extent, it gives the advantages above enumerated for the center-bearing rail, but only to a limited degree.

The "side-bearing" pattern, with its many variations, is that which is most generally in use in the United States, not because it is the best, but because it is the best that the railway companies are permitted to put down, as wagon-wheels can readily get on the track, and it gives a good wide tramway for general travel. This very fact, however, is a great detriment, as the general traffic is invited by its smoothness and other advantages to run upon it. Heavy teams going at a slow rate are constantly in the way of the faster moving cars, and the rails are not only worn out by this travel, but the speed of the cars

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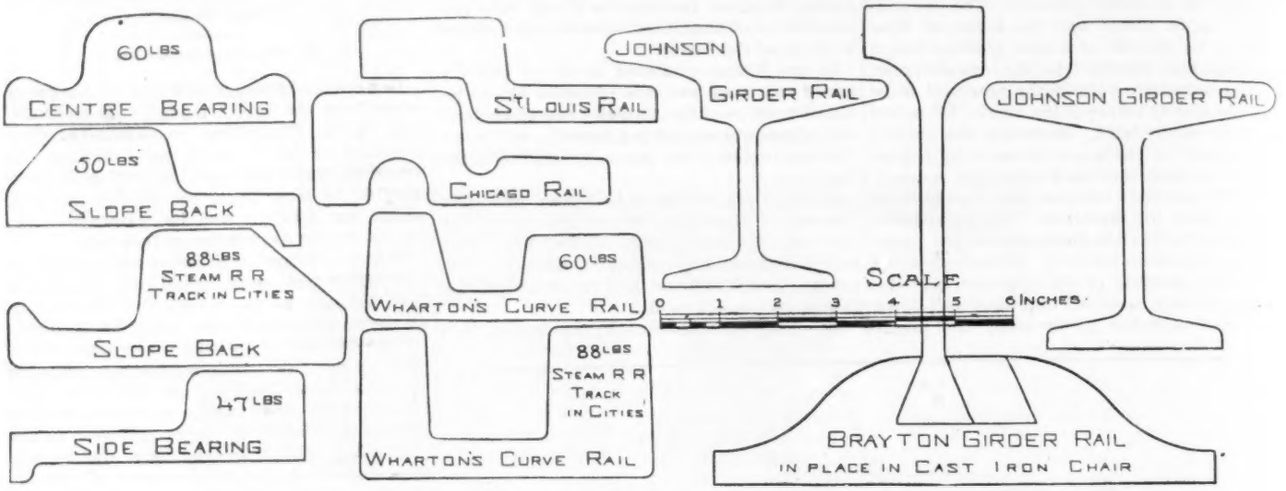


**Street Railways in the U. S.; Types of Rail.**

and the general business of the road interfered with. A very serious objection to all side-bearing forms, is that the weight of the cars being entirely on the outer side, that part of the rail wears into the stringer sooner than the other, causing the rail to roll out of level, thus widening the gauge of the track. All forms in which the head of the rail is narrower than the tread of the car-wheel should be avoided, as the wearing surface is too little, and in the side-bearing patterns, this is especially the case, for, unless the head is as wide as the tread, the projecting edge of the wheel will be constantly striking against the paving stones outside of the rail when the track is new, or the pavement is re-laid. This will only cease when the paving stones shall have been gradually worn away by the action of the wheels, which is a very objectionable and costly process, or when they shall have been knocked down or otherwise settled below the head of the rail.

In England and in some other countries the standard rail for street railways or tramways is a flat rail having a narrow groove in it, just wide enough to admit the passage of the car-wheel flanges, but not wide enough to allow the wheels of any ordinary vehicle to get in it. Such a rail, although in some respects the best for traffic other than the railway cars, could not well be used in this country, particularly in the northern parts, owing to the liability of the narrow grooves being clogged up with dirt or mud. This would especially be the case in winter, as it would be almost impossible then to keep the cars upon the track, as the grooves would be constantly getting filled with frozen mud or ice. Although rails of this form allow wagon wheels to cross them freely in all directions, this very thing is of itself a drawback to the use of the railway track by ordinary vehicles, as there is nothing to keep them in line upon the rails. Street railways or tramways give a first-class opportunity for the hauling of heavy loads of freight through cities in ordinary wagons, and if the flat English grooved rails were used, they would, for the reason just stated, not be as good for that purpose as rails of the usual forms used in the United States.

Where the service is heavy, a rail weighing sixty pounds to the yard will be found the most satisfactory, and in the end the most economical; but upon roads with lighter travel this is not necessary, though it should always be born in mind that it is impossible to get satisfactory results when materials of poor quality or insufficient size or weight are used. It is not the first cost that should be regarded altogether, for if the railway is well built with good and sufficient materials, the annual wear and tear will be proportionately reduced, so that the profit and loss account from year to year will not be charged with constant repairs, rendered needful by poor or scanty construction at the outset.

The spike-holes should be about twelve inches apart, so that when the rails are first laid, it will be enough to spike every alternate hole, thus leaving new holes with their original countersink to be used when the others shall have become worn too large and be unfit to retain the spikes. The rails should be carefully inspected, and any that are not cut square at the ends, or not straight and level, should be rejected and returned to the mill.

As the gauge of street railways is almost always established by the local authorities to conform with the legal gauge of the ordinary vehicles of such city, there is, in consequence, no universal or standard gauge for them. From four feet eight inches to five feet two inches gauge will give the most satisfactory results, as a general rule, especially for double teams, as there is not sufficient room for the horses to travel properly if the gauge is less than four feet eight inches, without their treading upon the smooth surface of the rail, which would probably cause them to slip and injure themselves.

Where double tracks are laid, there should be ample space for the cars to pass each other on both the straight tracks and the curves. Five feet between gauge-lines, unless the cars are exceptionally large and wide, will be a sufficient distance; and on straight tracks it will also allow a man to stand between the cars while passing each other, which may prevent many accidents.

All joints of the rails should have rolled iron joint-plates, not less than eighteen inches long, placed under them. These should have vertical flanges to fit against the sides of the rails, so as to keep them in line with each other, and to increase the vertical strength of the joint-plate itself. If the track is laid in cold weather the joints of the rails should be kept apart three-eighths of an inch to allow for expansion of the rails in summer; and this space should be less as the temperature rises, although the ends of the rails should never be laid less than one-eighth of an inch apart even in mid-day of the very hottest weather.

The rail-spikes should be five and a half or six inches long, of one-half inch square iron, with countersink heads, to fit into and not project above the countersink in the rail itself. They should be of good tough iron, so that when driven, the heads will not fly off under the strokes of the hammer.

As street railways are now usually constructed, the rails are placed upon longitudinal wooden stringers, resting upon transverse wooden cross-ties. Where it can be obtained at a reasonable cost, yellow pine, free from sap-growth, and cut from trees that have not been tapped, should be used. As a general rule, the best yellow pine railroad lumber is brought from Georgia or Florida, and in all cities near the seaboard, at least, the rate of freight is low enough to justify its use for stringers and cross-ties. Of course, this may not be so in cities or towns far inland, and in such cases, other lumber must be used which can be more conveniently and reasonably obtained. The ties should be of equal size, in order to give a uniform bearing and support to the track; for if they are of unequal surface, the track will be better held up by the large ties than the smaller ones, thus causing it to be uneven and irregular. For the same reason, they should be placed at a uniform distance apart, five feet from center to center, being, probably, the most desirable. Uniformity of dimensions can be more certainly had if the ties are sawed than if hewed, and in addition to this the stringers will then always have a good flat bearing upon them. The joints of the stringers should never be under the joints of the rails. The stringer should be not less than seven inches deep, and of the same width as the rail which is to lie upon it, unless it should be one of the narrow forms of rail, in which case the timber should project on both sides not more, however, than one-half inch. It should then be beveled off on the upper edges to the width of the rail before putting down the pavement. The stringers should be, at least, twenty-five feet long, in lengths divisible by five feet, so that there will be no waste in cutting off useless ends to allow the joints of the stringers to come exactly upon the cross-ties. Of course, where there is exceptionally heavy service, it may be of advantage to place the ties four feet from center to center, and the size of the ties may then be increased to advantage, say five inches high by seven inches wide, although generally four inches by six inches is large enough. The ties should project outside of the stringers on both sides at least nine inches, and the stringers on the outside should be fastened to the ties by cast-iron knees, not less than six inches high and six inches long, and on the inside by similar knees three inches high and three inches long. The large knees on the outside tend to keep the stringer in a perpendicular position and so to preserve the gauge of the track. At all joints of stringers, joint knees should be used on both the inside and outside of the stringers, and they should be broad enough to bear against and be spiked to the contiguous ends of the same, thus keeping them in line. The spikes used for these cast-iron knees should be three and a half or four inches long, and three-eighths of an inch

square, with button-heads. The knees should be of good strong iron, so as not to break easily, in case the workman should miss the spike and accidently hit the knee itself, and all the spike-holes should be carefully drifted out, so that in driving the knee-spikes, they will not wedge in the holes and split the knees.

It is very important to have the ties and stringers well and solidly tamped-up, and a straight line and even surface carefully obtained. This is a matter which is often slighted but which should be attended to with great care.

A very troublesome and expensive item of repairs is often caused by the wheels of heavy wagons making ruts alongside of the rails, thus causing the track to get out of gauge, and otherwise wrenching and injuring it. This can be, in a great measure, prevented by putting a row of substantial square-shaped paving blocks on each side of each rail, which, after being thoroughly rammed, should be left about one-half inch above the rail, otherwise they will settle down so as to be below the rail, when their efficiency will be greatly lessened. Although it is very seldom done, it is a great advantage to bed the block stones next to the rails upon a layer of concrete, which will greatly help to keep them from being pressed down out of position.

All the undisturbed bed between the cross-ties should be loosened up with the pickaxe, so that all of the pavement shall have the same bearing, and it will settle alike all over.

The best pavement for the horse-path is, probably, had by using cobble stones about si_ inches long, about four inches wide, and two or three inches thick. These dimensions give stones of moderate size, and of flat, oval form, so that when closely set on end, they furnish a very good foothold for the horses, and the pavement can be kept in repair at a very reasonable cost. The horse-path should be paved as nearly as possible level, and all crowning or elevation in the middle of the track should be avoided, so as to allow the horses' feet to travel evenly and squarely. The stones should be laid upon a bed of good sharp gravel or coarse sand not less than six inches deep; they should be thoroughly rammed three times, and left with a covering of the same material about one-half inch deep, from which all stones over an inch long should be raked off. As by far the greater number of horses worn out in street railway service become so from injuries or weakness of their feet or legs, this matter of suitable pavement is a very important one to street railway companies, and it has been proved beyond doubt that horses traveling upon cobble stone pavement carefully and properly laid, last longer than when any other form of pavement is used.

At proper and frequent intervals suitable connections should be made with the sewers, or with surface drains where sewers are not in use. If this matter is not properly attended to, great inconvenience and expense will be caused, especially in cities where the melting of snow during the winter causes a great accumulation of water upon the track, which, if not promptly removed, may, by a sudden change of weather, freeze up solid on the track. In any event, no track can be properly kept in order unless the surplus water is promptly and adequately drained off. The general elevation of the whole track should be a little higher than the rest of the street, to aid in draining the water away from the track.

The radius of the curves will be governed by the width of the streets and other conditions, but it is always desirable to avoid curves of small radius. A curve of fifty or sixty feet radius is probably the most desirable when it can be laid down; but in many cities the width of the streets will not permit curves of more than thirty or thirty-five feet radius, which, however, if properly laid, will give all reasonable satisfaction. The curved rails should be of the grooved form, on both the inside and outside lines of the curve, although in curves of large radius it is not necessary to have the outer line laid with grooved rail, in such cases bending the rail used upon the rest of the track to the proper shape. The groove should be about one and a half inches wide, and the inner side, or guard, of the grooved rail, should not be more than three-eighths of an inch above the tread. Great care should be taken in laying the curves to have them of regular curvature, uniform gauge, and with no abrupt changes of surface. Ordinarily, a curve laid with the inner and outer rails on the same level will give the best results in service, but there are instances, when, from the grade of the streets, it will be found necessary to elevate one rail higher than the other. The outer rail may then be elevated a few inches above the inner without any disadvantage; but the inner rail should never be higher than the outer, if it can possibly be avoided, although a slight difference in this respect, where absolutely unavoidable, can be allowed, if the curve is very carefully and accurately put down. The curves should always be so constructed that all four wheels of the car will bear equally upon the rails; as otherwise; if any one of the wheels should have its portion of the load removed from it by reason of a depression in the track, it will have a tendency to run off the curve at that point. The curved rails should be, when practicable, in length of thirty feet, so as to have as few joints as possible; and a straight guard rail, not less than seven feet long, should be attached to each end of the inner line of the curve.

On single-track railways where it is necessary to have turnouts, or passing places, they should be so constructed as to allow the cars to run easily into and out of the turnout. This can be accomplished by making the curves leading into and out of the turnouts of large radius, say three hundred or three hundred and fifty feet. As, however, in cities, the length required for this form of turnout is often inadmissible, it will then be necessary to use curves of shorter radius, and a turnout with grooved rails of seventy-five feet radius, will, probably, be found the most desirable under such circumstances. Where the curved rails of the turnout are of three hundred or three hundred and fifty feet radius, it will not be necessary to use any grooved rails, as the ordinary rails, when carefully curved, will be sufficient to guide the car-wheels.

The castings for all switches, frogs and crossings should be made from hard, tough iron, and of substantial size and weight. At each end of the casting, there should be a recess or pocket of the right size and shape to support and retain in position the end of the adjoining rail; or, when two castings themselves abut, the end on to which the cars run should rest in a pocket formed in the end of the other casting. Particular care should be taken to have all the castings evenly and solidly bedded upon the timber supporting them, for otherwise they are liable to be broken by the shocks and strains of heavy loads crossing over them. At places where frogs or crossings are required, and one of the tracks is used very much less than the other, it will often be found desirable to have the castings so made as to allow a continuous rail to run through a recess in the casting, thus giving an unbroken rail to that one of the tracks which has much the greater travel, while the occasional cars running on the other track have their wheels so raised up that their flanges pass readily over the top of the continuous rail. "Toe-pieces," or slight projections, should be made on all castings, when, by the size or smoothness of the surface exposed, horses are otherwise liable to slip upon them, smooth spaces being left only where the car-wheels run.

As the standard depth of the flanges of wheels on street cars is only nine-sixteenths of an inch, while the standard depth of flanges of car wheels on steam railroads is one and a quarter inches, it is evident, that great care must be taken to have all curves, crossings and switches on street railways made with accuracy and put down very carefully.

The use of turntables should be avoided wherever it is possible, but as they will often be found necessary, it is important that those only should be used which will turn easily, present little or no obstruction in the street, and require but a reasonable amount of repairs when in use. They should be set on brick or stone foundations laid below the frost-line, and they should be thoroughly provided with drainage.

Within a recent period, and especially within the last five years, a very radical change has taken place in the manufacture of rails, whether for steam or horse railroads, the material now used in the construction or repair of railways being almost universally steel instead of iron; in fact, it would be very difficult to get iron rails, as the mills that formerly made them have gone out of the business, or have changed their plant to make steel rails instead. The improvements in the manufacture of steel have been so great that there is now no inducement to use the inferior article, as the superior can be had at the same or a less price. The service of steel rails on an average street railway is, probably, at least three times that of iron rails of equal size and weight, the wear of the steel rails being also more even and regular. One great cause of the rapid deterioration of iron rails furnished for street railway use, arose from the fact that they would laminate and often split off in pieces of considerable size, so that the surfaces were not only worn away, but actually broken away and splintered off. Steel rails, on the contrary, being of homogeneous and tough material, are not subject to this objection, every particle that is worn off under service coming away by itself, but not dragging with it any other portion of the mass.

Up to this time I have not referred to the various forms of girder rails, largely used in European cities, and within the last few years introduced to a considerable extent in the United States, by which wooden stringers and ties are altogether avoided. One great advantage that they give is that a perfectly secure and level joint can be had at the ends of the rails, as fish-plate joints can be used similar in general character to those in use on steam railroads. The deterioration of the railway by reason of the decay and wearing away of the stringers and ties is avoided, as no timber is used with them. Thus not only is a much smoother track obtained by their use, but the durability and life of the railway is very much increased. It is almost certain that the standard street railway of the near future will be constructed with steel girder rails, set on iron or steel supports, or cross-ties, and held to gauge by iron tie-rods.

In the Johnson system of girder railway construction, the rails, when laid in the street, present the same form and appearance as those of the usual kinds. Various forms of side-bearing and centre-bearing rails are made by this system, but they have a stem and base attached to and forming a part of the rail, very similar in general appearance to the stem and base of the ordinary T rails. This stem and the base are made of any desired height or thickness, and being rolled in one piece with the rail itself, the whole structure is very firm and strong, both laterally and vertically. The Johnson girder rails are supported in suitable iron chairs, of either rolled or cast-iron, and cross-ties of either metal or wood can be used with them. Many miles of tracks have within a few years been laid upon this system in the United States, and the new cable railway on the Tenth Avenue and One Hundred and Twenty-fifth Street, New York, is constructed with them. In this case they rest in recesses of the cast-iron yokes of the cable conduit, which are placed about four feet apart from centre to centre.

In the Brayton system of girder railway construction, as in use in Providence, Rhode Island, where a number of miles have already been laid or are in process of construction, the depth of the whole rail is seven inches. Cast iron chairs or supports twenty-four inches long, placed seven feet six inches apart from centre to centre, and resting upon concrete foundations, receive and hold in upright position these girder rails. The lower end of the Brayton rail is made somewhat larger than the stem, so that when placed in these chairs and suitable wedges are driven in, the whole structure becomes very firm and solid. Iron tie-rods one and a half inches wide and one-quarter of an inch thick, are placed every seven feet six inches apart from centre to centre. These tie-rods extend through the stem of the rail near the top, and are secured with nuts both inside and outside, thus keeping the rails in a vertical position and preventing the track from spreading. The tie-rods being placed on edge, present no difficulty in paving the street as they take up but little room.

No allusion has been made in this paper to the construction of cable railway conduits, which form a different branch altogether of the subject, and which might properly come under the head of propulsion or motive or motive power.

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## CLUBBING ARRANGEMENTS.

### 1886.

The "subscription season" for the most popular American Magazines is close at hand, and inquiries as to our proposed clubbing arrangements are being made. We beg leave to announce, therefore, that on and after JANUARY 1, 1886, the subscription price of ENGINEERING NEWS will be **$5.00** per year; until that date the price and clubbing rates with other publications will remain as given below.

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| Atlantic Monthly | $3.25 | $4.00 |
| Century Magazine | 3.55 | 4.00 |
| Harper's Magazine | 3.25 | 4.00 |
| Harper's Weekly | 3.25 | 4.00 |
| Harper's Bazar | 3.25 | 4.00 |
| Harper's Young People (weekly) | 1.65 | 2.00 |
| Popular Science Monthly | 4.25 | 5.00 |
| St. Nicholas Magazine | 2.5[illegible] | 3.00 |
| North American Review | 4.10 | 5.00 |
| Cassell's Magazine of Art | 3.00 | 3.50 |
| Cassell's Family Magazine | 1.25 | 1.50 |

The Century Magazine commences its year with the November Number; Harper's Magazine commences with the December Number. Subscribers should renew these Magazines in October and November.

Subscribers to other publications clubbed with ENGINEERING NEWS, must notify those "other publications" direct, of change of address during the year. After we have transmitted for the year's subscription and had the subscriber's name and address properly entered on the clubbing lists, our connection with the transaction *ceases entirely*. Our margin of five cents on each subscriber does not allow for much extra expense in time and postage and stationary.


THE late Mr. John C. Trautwine, C. E., was widely known among mineralogists for the completness and uniform excellence of his cabinet of specimens. We have just been informed that this collection, the life time work of an intelligent enthusiast, is to be sold by the executors of his estate at private sale.

The specimens number about 6,000, are in perfect condition, of approximately uniform size, and are substantially and neatly arranged in six cabinets of sliding trays; each specimen is labelled, when possible, with name, locality and chemical composition.

With Mr. Trautwine's own professional reputation, and his wide acquaintance among civil engineers, his opportunities for gathering representative and choice specimens was peculiarly great, and has resulted in a collection that in scientific and practical value is not exceeded by any private collection in the United States. Any further information concerning it can be obtained from John C. Trautwine, Jr., 262 S. Fourth street, Philadelphia.

PROF. W. A. ROGERS, of the Harvard Observatory, has reported to the American Academy of Arts and Sciences, in Boston, the results of his observations on the transmission of shock from the Flood Rock explosion.

The air-line distance between the observatory in Cambridge and Flood Rock is 190 miles, and the observations were timed as follows: Disturbance first seen, 11.17.14; instant of maximum disturbance, 11.18.03; disturbance ceased, 11.20. The figures are all in seventy-fifth meridian or "Eastern" time. The method used to develop the existence of vibration was the placing of a saucer of mercury on the solid cellar floor. In this mercury was a speck or flaw. Upon this point was brought to bear a microscope of 750 magnifying power, the spider line being in exact coincidence with the flaw.

The first vibration perceived was about a thousandth of an inch, and recurred at intervals for nearly two minutes, the greatest swaying of the mercury being over a space of one five hundredth of an inch.

In this connection it is interesting to note that Gen. Abbott reported that the shock from 50,000 pounds of dynamite, exploded in 1876 at Hallets Point, was transmitted through the drift formation of Long Island, at the rate of 5,300 feet per second for 13½ miles. Assuming the figures of the Cambridge report as correct and that the mine at Flood Rock was exploded at 11.14, seventy-fifth meridian time, it took the wave just 194 seconds to travel 190 miles, or at the rate of 5,120 feet per second. This is very near the rate of transmission observed by Gen. Abbot when the greatly increased distance is taken into account.

### Municipal Engineering.

As part of our programme for the coming year we would announce to the readers of ENGINEERING NEWS, that we have now in active preparation a series of papers upon city engineering, which we expect to make interesting and very valuable.

Municipal engineering, especially as applied to American cities, is not susceptible of general treatment; our territory is too extended, and the conditions of location are too much varied. It is very evident, for instance, that a practice well adapted to the surroundings of Boston would hardly suit the needs of Charleston or New Orleans, and a similar rule would hold good in our western cities. This fact undoubtedly accounts for the extreme poverty of the present literature upon this subject.

It is in the full appreciation of this condition of affairs, and with the purpose of meeting a very evident demand for information upon a matter that is rapidly increasing in importance with our growth and prosperity, that we have settled upon the following plan in the proposed series of papers.

It is our intention to describe in all its detail and with all the illustrations possible the latest *actual practice* in city engineering in each of our more important cities, each city to be separately treated. It is our purpose to give the practice as we find it, the bad as well as the good, but with such remarks and examples as will show why it is bad in the case under consideration. In the preparation of these papers we have formulated a uniform system of treatment, so that each point will be taken up and disposed of in such order that the practice in each locality may be compared intelligently and with the prevailing conditions taken into full account. With this record of actual practice, in various localities and under many conditions, before the city engineer, we see no reason why the special requirements of any new situation cannot be readily deduced. In any event the old official as well as the beginner will have example and experience before him such as only much outlay of time and money can otherwise secure. We enter into this scheme with the full conviction that to carry out our purpose in the manner that we propose, so that it may be of actual practical value, will be very troublesome and expensive; but we also feel assured that if well done it will bring its own reward among our appreciative readers, and that in any event we are doing our duty in thus publishing, in an available form, information that that is desirable and extremely valuable to an important class of our patrons, but that is now practically inaccessible.

This work will be done either by our own staff or by the best authority on the subject available in each of the cities. We have under preparation at the present time the cities of New York, Philadelphia, Boston and Providence. To this latter city, which has a well-earned reputation as a model city in its management of public works, we expect to devote especial attention, and our data will come from the very best authorative source of information.

The field to be covered may be outlined about as follows: The area, population, and location of the city to be described; its water supply, sewerage system, rainfall, frost penetration, geological and topographical features, etc. The organization of all departments having control of public works, with their duties. The various systems of street paving, sidewalks, street cleaning and watering; street lighting, etc. The regulations controlling all sewer, water and gas connections, with fees; the opening of new streets, control of contractors, street railways, telegraph wires, etc., will all be described and, when possible, illustrated. The purpose is to omit nothing that will be of value that can be properly treated in such a series of articles as proposed.

In this publication we wish to enlist the hearty co-operation of all interested in the subject, and our columns will always be open to any suggestions, well founded criticism or details of novel but good practice in other points than these we may ourselves reach.

### Dredging at Flood Rock.

The detail of bids, given elsewhere in this issue, for the dredging of the broken material from Flood Rock shows a decided advance in cost since the execution of similar work done at Hallet's Point in 1878.

According to the specifications, the work to be done by the present contractors is the removal of 30,000 tons of broken rock; the "contractor to do his own surface blasting;" the rock to be first taken from the "Nigger Heads" until there is over that reef a clear depth of 18 feet, and then to commence over the "Hen and Chickens;" the rock removed is to be dumped between Hog's Back and Ward's

Island, or "otherwise disposed of," and finally the contractor must work two dredges continuously, commence work on November 1, next, and complete his contract by July 31, 1886. The price bid is per ton of 2,240 pounds measured in scows.

The bids for this work, as opened on Wednesday, range from $3.19 to $3.90 *per ton*. This figure reduced to cubic yards, is $6.38 to $7.80, as one ton of this rock is almost exactly two cubic yards. At Hallet's Point, the price at which the contract was let for rock dredging, on November 24, 1877, was $2.29 per ton, or $4.58 per cubic yard. The successful bidder in that case, was the same Atlantic Dredging Company, of Brooklyn, which is again the lowest in its figures.

If the dredging of broken rock is to cost $6.38 per cubic yard in the present work, we must say that we can hardly see where the economy of the system adopted at Flood Rock comes in. We understood that it was cheaper to dredge than to excavate in the galleries; but the average price of tunnel excavation, in a very similar rock in the new Croton Aqueduct, is only $6.54 per cubic yard, on the Brown, Howard contract, and the section is practically the same. If the dredging alone is to add about $1,250,000 to the cost of this improvement, it might have been cheaper after all to have robbed the pillars somewhat more, and likewise to have thinned the roof. The clause in the specifications, that the contractor is to do his own surface blasting, may have had some weight in raising the bids, as we understand that a cube of 6 feet, representing 15 tons, is the maximum capacity of the most powerful dredges to be used, and any rock exceeding these dimensions, must be broken at the contractor's expense.

### The Future Water Supply of Minneapolis, Minnesota.

Mr. J. T. Fanning, Hydraulic Engineer, has by invitation of the City Government been making an exhaustive examination and report upon the improved water supply of Minneapolis. We give an abstract of this report as follows:—

From the reports of the chamber of commerce Mr. Fanning finds that the general average gain in population is nearly 20 per cent.; values of property, 22½ per cent.; in leading industries, more than 20 per cent., and in remaining industries 31.77 per cent.

From this basis, and allowing an average consumption of 100 gallons per head, he figures that in 1896, the population will be 804,926 and the daily volume of water required will be 80,492,600 gallons; the daily power demanded will be 53 mill powers of 75 gross horse-powers each. At an average increase in population of only 16⅔ per cent., the population in 1896 would be upwards of 600,000 and the daily consumption, 61,333,000 gallons.

For the distribution system, the first estimate above would require in the year named, three 48-inch mains, or five 34-inch, or eight 30-inch.

In the matter of pumping machinery, the present plant on the West side is in good condition, but the combined safe capacity is only 17,750,000 gallons, with a purchased power of 450 horse-power, enough to pump 9,000,000 gallons daily against 55 pounds pressure per square inch. On the East side there is a pumping plant of 5,750,000 gallons capacity, with power enough to pump 7,250,000 gallons. The combined works thus appear to have a pumping capacity of 23,500,000 gallons, and power enough to pump 16,250,000 gallons daily. On the basis of demand assumed the present pumping machinery will suffice for two or three years yet.

With continued prosperity and increase, Minneapolis will require within ten years, 80,000,000 gallons daily and 3,000 horse-power to supply it, in continuous service. Unless the proprietors of the water power of St. Anthony's Falls shall soon supplement the water with steam power to protect their patrons against the contingencies of anchor-ice and extreme drought, the city will soon have to discuss the necessity of a steam pumping plant for its use and protection.

Mr. Fanning then considers the details of the new intakes, high and low service and reservoir sites. In the matter of income he puts the annual increase at 42 per cent., and thinks that 20 per cent, per annum should be gathered from the cost of piping the miles of streets yet without mains, this income should be set aside to pay for future work. A low service reservoir is recommended at a cost of about $150,000.

Commissioner Davis objected to the report as not giving definite information on the relative merits of the direct pressure and reservoir systems; he thought the entire report was a direct blow at the "Jumbo" pumps, and he (Davis) proposed to stand or fall by those pumps, having staked his reputation upon their success. In his opinion the direct pressure of 100 pounds per square inch was equal to any other system that might be devised.

Engineer Waters also criticised the report in regard to water-waste, and said that the waste at Manchester, N. H., was 40 per cent., or very much more than at Minneapolis. The discussion of the report is to be continued.

### Sand-bag Embankments.

The last number of the Proceedings of the Engineer's Club of Philadelphia (No. 2, vol. V.) contains a paper by Percy T. Osborne, C. E., on the construction of a sand-bag embankment to close Little Inlet, Brigantine Beach, New Jersey.

The inlet from the sea that it was proposed to close was 831 feet wide; the main channel in this opening was 196 feet wide and 17 feet deep in the deepest part. Ordinary salt-bags were used to hold the sand; these bags cost 5½ cents apiece and contained when packed 2½ cubic feet. The bags were filled within 100 yards of the embankment and wheeled on a barrow to place, 1,050 bags being placed in ten hours, or 105 bags per hour. The cost per cubic yard in place amounted to $1.00; 12 bags costing 66 cents and the filling, sewing and placing 34 cents.

In building the embankment, work was done from half ebb to about half flow of tides. The bags were given direction by hand and allowed to sink with as much regularity as possible so as to form layers at the base of the embankment, which was thus built up to within one foot of low-water and the top levelled. On these bags, as a foundation, frames 6 feet high and 12 feet long were placed. These were made of 2 and 3-in. planks put 8 feet apart. In section they had the form of a trestle-bent, the cap (12 feet long) and the sill (15 feet long) being in the form of boxes about 12-inches square; the batter posts were planks and the bents were connected by planks running longitudinally about 2 feet apart. The space between these frames was filled with sand-bags, the intention of the frames being simply to confine these bags in place.

The foundation layers were put down in stretches of from 40 to 56 feet from each shore leaving the channel unchecked. On this foundation the embankment was raised to its full height within the frames, and the foundations again advanced. In closing the main channel, an old scow filled with 200 bags of sand was first sunk as a nucleus for the remainder, and after 42 days work the last opening was closed and the sea was effectually shut out.

The embankment withstood heavy seas and strong southeast gales for nine days, when a breach, 50 feet wide and about 2 feet deep, was made in it, which afterwards increased to 132 feet in width. The work was left in this condition, but inspection showed that in the nine days that it was closed, the channel depth had been reduced from 13 feet to 2 feet, and the sand had filled in along the whole front of the embankmnt so that 2,000 feet of beach had formed in front of it, which was dry at low-water. The 80,000 bags of sand used had practically closed the channel and reclaimed 30 acres of beach on the bay-side and 70 acres next the sea.

### Flow of Water Through Sand.

The *Zeitschrift des Vereins Deutschen Ingenieurs*, No.'s 31 & 32, 1884, gives the following formula by C. Kroeber, C. E., of Stuttgart, to determine the flow of water through sand. The formula gives results within ± 13 per cent. of the actual flow:

$$Q = 1728\, F \left( \frac{d\,h}{d + 900\,l} \right)^{\frac{8+d}{8+2d}}$$

$Q$ represents the flow in *liters* per second; $F$, the total area of the cross section of the permeable stratum in square meters; $h$, the effective height of pressure in meters; $l$, the thickness of the layer of sand, measured in the direction of the flowing water, in meters, and $d$ is the average size of a grain of sand in millimetres.

### A Novel Dredger.

The Illinois Agricultural Co., of Rantoul, Ill., are the owners of a large body of swamp land, 5,000 acres, which they have redeemed by drainage. An account of a new dredger or hydraulic plow, which they are using to clean out and deepen their main drainage canals, may be of interest to some of the readers of the NEWS. The new and novel princinciple consists in the motive power employed, the water in the ditch to be deepened.

The machine consists of an immense plow, with a mold-board 42 feet long, on each side; the construction of the plow is such, that when placed in the ditch, it forms a dam, the pressure of the water behind which forces it down stream. Experiments have shown that a head of 5 feet behind the plow, is sufficient to force it down stream at from one to two miles per hour, in a ditch 60 feet wide on top, 20 feet wide at bottom, and 6 feet deep, and throw out one cubic yard of earth, mostly stiff clay, per linear yard of ditch. Even with the rude experimental machine, the expense for attendance and supplementary power, will average about $\frac{1}{10}$ of a cent per cubic yard. The machine can be made by unskilled labor, and need not cost much more than $200.

The inventor also constructed a movable dam, to be attached to the front of the plow, and thus render available the bouancy of water; in this case the water acts upon the dam, which draws the plow after it. On trial, the inventor found he had ample power, and hence discarded this device.

Practically, a little supplementary power, either the direct pull of cattle or horses, or a capstan, is desirable in controlling and guiding the machine. When a new ditch is to be opened, the ditch is started with the supplemental power. The machine is specially useful in cleaning out the silt from the large drainage canals, now largely used as an outlet for the drains. The company referred to above have fifteen miles to construct, which will cost $30,000.

PARIS receives annually an income of about $300,000 from the public squares, parks, and avenues, by leasing space for booths, restaurants, drinking and amusement halls. So says the *Zeitschrift fur Bauhunde*, 1884, p. 417.

## PERSONAL.

MR. ROBERT B. ROOSEVELT, who was appointed by the President commissioner to examine the section of the Northern Pacific Railroad, just completed, has declined the position.

MR. A. J. SWIFT has been appointed chief engineer of the Delaware & Hudson railroad, northern department, vice Charles H. McKee. He assumes the position on November 6th.

AT Falmouth, Mass., by the Rev. William J. Potter, assisted by the Rev. J. M. Craig, on Wednesday, October 7, 1885, DANIEL BONTECOU, of Kansas City, Mo., to NATHALIE HOLDREGE.

CLARK W. T. THOMPSON, the builder of the Southern Minnesota, and the largest contractor of Pioneer days in the northwest, died at Wells, Minn., October 11th, from the effects of a paralytic stroke.

W. D. GELLETE has resigned his position as Chief Assistant Engineer of the Central Pacific R. R. to take the office of General Manager of the Pomona Land and Water Company, with quarters at Pomona, Cal.

C. L. STROBEL. C. E., Consulting Engineer of the Keystone Bridge Company, has opened an office of this company in Chicago, In addition to his duties as agent and engineer of the company named, he will also design and take charge of the execution of other structural work as engineer, or give engineering advice in such matters.

JOSEPH J. DE KINDER, who has been doing excellent work under Col. Ludlow as Superintendent of the Philadelphia Water Department, has resigned his position for reasons not stated. JOHN L. OGDEN, connected with this department for many years as Assistant Engineer in charge of distribution, has been appointed to succeed Mr. de Kinder as Superintendent.

ON the Atlantic & Pacific, N. A. Drake, chief engineer, and J. Moylan, assistant engineer, have resigned and their positions are abolished. F E. Nelson is appointed superintendent of road department. Geo. F. Chalender, assistant superintendent of motive power and machinery has resigned, and his office is abolished. James G. McCuen is appointed superintendent of motive power and machinery.

MR. THOMAS DAVIDSON, F. R. S., F. G. S., the well-known savant, is dead. He was born in Edinburgh on May 17, 1817, and received most of his education in France and Italy. For several years he was a favored pupil of Paul Delaroche. His researches were principally connected with geology and palæontology. The degree of L.L.D., was conferred upon him in 1882 by the University of St, Andrew's.

MR. W. B. PARSONS, JR., has resigned his position as Roadmaster of the Susquehanna, Div., Erie Railway, and has opened an office as Civil Eng. at 35 Broadway, N. Y., Room 73.

Mr. Parsons, a graduate of the School of Mines, has been for several years in the service of the N. Y. L. E. & W. R. R. Co., during which time he has been stationed on five different divisions. Previous to his work on the Erie, he was engaged as engineer of the Blossburg Coal Co., and in various positions on railroad construction. This extensive experience, together with a reputation secured by the authorship of "Turnouts" and "Track," will place him in the front rank of the profession in this city. His specialty will be all kinds of railroad work, examinations, surveys, construction and maintenance of way, but he will also give attention to other branches.

### Horses vs: Asphalte Pavements.

The fire department of Berlin, (Germany,) has collected statistics about the accidents to horses, driven over asphaltum pavement. The companies which had to drive only twenty-eight to ninety-three miles a year over asphaltum pavements had one accident to every twenty-three miles; those with a yearly travel of 250 to 375 miles had one to every eighty-two miles, and those with a yearly travel of 930 to 3,728 miles for every 562 miles. This proves that the probability of accidents to horses, driven over asphaltum pavements, decreases with the distance driven.—*Verwaltungsbericht der Berliner Bauverwaltung*, 1884, p. 469.

### American Society of Civil Engineers.

At the meeting of last Wednesday evening, at the House of the Society, an excellent and interesting paper was presented by Mr. W. W. Evans, calling attention to the merits of the rack-rail system of railroad, in mountainous regions. The author first described the "ladder" type of road as seen at Mount Washington, and then entered very fully into the detail of the Abt system of "rack-rail," now in use in Switzerland and being still more extensively introduced into the hitherto inaccessible region of the Hartz Mountains. The reading of the paper by the Secretary was followed by considerable discussion by the members present.

### Panama Canal.

We learn from an engineer, connected as a contractor with the Panama Canal, that Mr. J. Dingler is not expected to return to Panama as Director General of the works, and that Count Ferdinand de Lesseps has promised the committee of the canal company, in Paris, to personally examine the canal works, in order to see if affairs are as bad as has been represented "by interested parties."

### The Technical Society.

The "Technical Society of New York," at its annual meeting, on the 10th inst., elected the following Officers and Trustees for the year 1885, 1886

*President*: Augustus Kurth, Civil Engineer and Tax Assessor, Municipal Building, Brooklyn.

*Vice-President*: Geo. W. Wundram, Board of City Works, Municipal Building, Brooklyn.

*Cor. Secretary*: Max C. Budell, 20 Nassau street, New York.

*Recording Secretary*: Max. Schwarz, 200, 202 Worth street, (cor Chatham), New York.

*Treasurer*: Alexander Droegmundt, 157 Bank street, New York.

*Librarian*: H. W. Fabian, 350 E. 9th street, New York.

*Directors:* Paul Goepel, Tryon Row; New York; Wm. Floohhausen, 281 Cumberland street, Brooklyn; C. Louis Nagel, 18 Dunham Place, Brooklyn.

*Chairmen of Sections*: Paul Bausch, New York, Section I: (Civil Engineer); F. Rudolphi, Brooklyn, Section II: (Mechanical); A. W. Cordes, New York, Section III: (Architects); not elected yet, Section IV: (Chemists, etc.)

MAX C. BUDELL, *Secretary*,
P. O. Box 1963, N. Y.

### Liquid Fuel in California.

A few months since the *Mining and Scientific Press* gave an account of the experiments which were being made by the Central Pacific Railroad Company, with petroleum as fuel on some of their steamboats. At that time they had tried it upon the freight steamer Thoroughfare, plying between Oakland and San Francisco, and on the transfer boat Solano—the largest ferry-boat in the world—on Carquinez Straits, running between Benicia and Port Costa. Since that time they have been able to determine more in detail concerning the results. On the Thoroughfare they saved $7,000 in the cost of fuel in the five months they were using oil as compared with the five months of the same season last year when they were burning coal. Besides saving 44 per cent. in actual fuel, they get rid of four firemen which makes an additional saving of $240 per month. On the Solano there is not so much saving, the cost being lessened but 17 per cent. She makes short trips, and they burn the fuel while she is in the slip to generate necessary steam. The oil costs $1.70 per 40-gallon barrel, or abour four cents a gallon. It is estimated by the engineer of the big Water Witch, which is also using oil, though a somewhat different kind from that used by the railroad company, that 100 gallons of oil are equal to one ton of coal, which latter costs about $7 per ton. The Oakland ferryboat Piedmont has just been altered so as to use the liquid fuel. She has not yet been put at work under the new system, but will be in a few days. The oil is spraved under the boiler by a steam jet, and is supplied by suitable tanks. A supply tank is kept on the wharf, so that the oil may be led into the steamer's tanks. The supply tank is filled from tank cars, so there is no handling. There is no smoke nor soot, and, of course, no ashes. It is stated that in addition to the lower cost of the liquid fuel the services of 16 firemen will be dispensed with on the Piedmont. The mechanical alterations to effect the change of system are slight. The other ferry boats will be changed to burn oil shortly.

## CORRESPONDENCE.

### Accurate Chaining.

EDITOR ENGINEERING NEWS: Another item in connection with the article on accurate chaining, in your paper of September 19, 1885. In that connection with the comparison of standards referred to in that article, (item 1), a metre tape, made in Paris, was sent to the office of the U. S. Coast Survey to be tested. It was correct to within 0.1 m.m. ($\frac{1}{254}$ of an inch); a comparison between this tape and the standard derived from the 2-foot steel rules, showed the latter to be correct to within $\frac{1}{10}$ of an inch. The 100-foot tape referred to the maker, at his request, he sent another which he knew was correct, for he had tested it, etc., by a "standard from Washington"; this tape, when compared with the metre tape above, was 0.67 inch too short.

This item ought to be a warning to those using tapes or chains, where absolute accuracy, (not great accuracy necessarily) is required, that the standard of the manufacturer is not always correct. Here also is a hint to the manufacturer. J. C. BAKER.

### More Water for the State Lunatic Asylum at Utica, New York.

The N. Y. State Lunatic Asylum located at Utica, New York, takes its water supply from a well situated in the town of New Hartford, distant, about two miles from the Asylum buildings in a direction very nearly due south from the city. Water is found in a gravel formation which in this locality covers an area of about one square mile. In an easterly and westerly direction the land is nearly level but has a moderate fall to the north, forming a stretch of plain, bounded on the east and west by low ridges, opening on the south into the valley of the Saquoit Creek and into the Mohawk Valley on the north. The Chenango Canal traverses nearly the center of this plain; the New York West Shore and Buffalo Railroad crosses it in a south-westerly direction; the Delaware Lackawana and Western Railroad crosses it diagonally from north west to south east, and the Delaware and Hudson Canal Company Railroad skirts the western border, then swings on a curve, crossing the Chenango Canal near the center of the plain, thence continues along the berme bank following the line of the canal and passes out at the southern limit; a highway leading from Utica to New Hartford village also passes through it in a south easterly direction. The land is used for farming purposes. The asylum authorities early appreciated the fact that good water could be obtained from this place in abundance, and to insure both quality

and quantity a considerable area was appropriated at the northerly end of the plain, including a large spring. At this point a well was sunk into the gravel 8 feet deep, 7 feet wide, 28 feet long and lined with brick, 20 feet is covered by a brick arch of 3 feet radius, and a 7 feet × 8 feet brick house built over the remainder.

The water rises through the gravel at the bottom and is taken into an 8-inch cast-iron pipe having a perforated strainer on the end and an 8-inch gate. The well, when full contains 9,240 gallons, but at present contains only 4,700 gallons.

The Globe Woolen Co., of Utica, by purchase secured water rights in a large section of this plain, in it were laid numerous lines of open jointed tile drains, conveying to a main of cement sewer pipe, laid with tight joints. The New York, West Shore, and Buffalo Railroad Company also purchased additional lands near the asylum appropriation; on it they sunk a well 20 feet in diameter, and 20 feet deep and located a pumping station tank and stand pipe. Though not very much used as a water station still the draught is appreciably felt at the asylum well. To avoid further encroachment on the supply and to prevent contamination from any source the asylum authorities submitted a bill to the Legislature asking for an appropriation of $10,000 for the purpose of protecting their water supply; the bill as passed in June, 1885, gave them but $5,000, and on the strength of this surveys and examinations were ordered with a view of ascertaining the extent of this water bearing gravel in the immediate vicinity of the lands now owned, and also the amount of land necessary to be taken to prevent encroachment and contamination. C. F. Carpenter, of Little Falls, N. Y. was the engineer engaged to make the necessary surveys and examinations. The object in view was to surround as nearly as possible the present appropriation by condemning strips of land 100 feet wide adjacent to the West Shore Railroad and the Chenango Canal and all the remaining lands between the several railroads and the asylum lands, twelve separate plots containing together 44 acres of land.

The examinations were of the simplest kind and were confined merely to ascertaining the comparative elevation of the water surface, as found by sinking test holes at different points on the lands proposed to be taken. Two laborers, in a day and a half, dug 13 test holes, ranging from 2 to 7 feet deep, and refilled them. The depth to the water was noted, and the elevations of the ground were taken afterwards with a level. Gravel was encountered in every case within a foot of the surface, and was a mixture of fine and coarse, free from sand and clay. No examinations were made to ascertain the magnitude of the supply of water, or the original source; the test holes showed the water available, over the whole area examined, and this was considered as sufficient evidence of an abundent supply for the requirements of the asylum. An approximate idea however was obtained by assuming that as there were 17 feet of water at the West Shore well, that a depth of 17 feet of water bearing gravel might be relied on over the whole area of one square mile. Fine and coarse gravel mixed, will hold about 84 per cent of its bulk of water, or 17 gallons of water to the cubic yard of mixed gravel, and the supply in 17 feet depth of gravel over the square mile of area, would therefore be 298,400,000 gallons, or 17,553,000 gallons per foot of depth. The water flowing in the bed of the Chenango Canal amounts now to about 10,000,000 gallons a day, and no doubt contributes, by percolation, its portion to this subterranean supply. There are also numerous surface indications of springs along the slope of the high ground bounding the plain on the west, which contribute also to the supply.

The majority of the supply no doubt comes from the Saquoit Creek bounding the plain on the south. This stream is largely used as a source of power for manufacturing purposes, chiefly in woolen and cotton goods, and the ponds at frequent intervals on the creek restraining the flow allow a free percolation through the underlying gravel. It requires no great stretch of the imagination to see in this level plain with its gentle fall toward the Mohawk River, the ancient bed of the Saquoit Creek as it might have existed in some remote time before accident enabled it to pierce the low intervening ridge, and find an outlet by a long detour into the same river at a point four miles further west. The facts and data gathered in the examination were embodied in a report to the Asylum Authorities, with a map showing the whole territory embraced in the survey, each plot being indicated by its metes and bounds and the average given; the whole was drawn to a scale of two chains or 132 feet to the inch, to conform to the canal maps on file with the State Engineer and Surveyor at Albany.

## The Naval Board on Unarmored Cruisers.

The report of the special board of naval officers created by Secretary Whitney to consider plans for the construction of the additional unarmored vessels authorized by the act of Congress of March 3, 1885, has been made public. The recommendations include the following:

For the two cruisers of not less than 3000 nor more than 5000 tons displacement, costing, exclusive of armanent, not more than $1,100,000, we recommend one twin-screw protected steam cruiser of the following general features: Length between perpendicular, 300 feet; beam, extreme, 49 feet; mean load draft of water, 19 feet; free board, main deck at side above L. W. L., 13 feet. The speed over the measured mile, under conditions similar to those prescribed in the Department's General Order No. 314, should be 18 knots per hour. The main battery should consist of two 8-inch and eight 6-inch breech-loading rifled cannon. The guns should be mounted on the upper deck without protection by armor other than a light shield on the gun. There should be a complete outfit for the Whitehead torpedo, suitable for six above-water launching tubes. The capacity of the coal-bunkers should be not less than 830 tons, and provisions should be carried for 300 men for 90 days, and other stores for the usual periods, though strictly limited to the actual needs of the service. The rig should be that of a brig without headbooms, and providing an area of plain sail of about 10,500 square feet. The engines and boilers should be designed with special reference to obtaining the maximum advantage from the use of forced draft, which should enable them to develop a collective indicated horse-power of 8500 under trial conditions for four consecutive hours, using the best quality of semi-bituminous coal specially selected for the purpose. The engines for actuating each of the twin screws should be of the direct-acting horizontal two-cylinder compound type, each, with all its appurtenances, contained in a separate water-tight compartment.

The second vessel of this size should be precisely similar and subject to the same conditions in all respects as the preceeding, except that the main battery should consist of twelve 6-inch guns mounted on the open deck on central-pivot carriages, and so disposed in sponsons and recessed ports that four guns may fire in a line with the keel at the bow and stern, and except that this vessel should have a light poop and forecastle and a bark rig, spreading about 12,000 square feet of plain sail.

For the heavily-armed gunboat of about 6,000 tons displacement, costing, exclusive of armament, not more than $520,000, we recommend the following as the general features of a steel twin-screw vessel. Length between perpendiculars, 230 feet; breadth of beam (extreme), 36 feet; mean load draft of water, 14 feet; load displacement, 1,700 tons; free board, about 6 feet, 4½ inches. The speed over the measured mile, under conditions similar to those prescribed in the Department General Order No. 314, should be 16 knots per hour. The main battery should consist of 6-inch breech-loading rifled guns mounted on central-pivot carriages, with segmental steel shields two inches thick. Four guns should be mounted on sponsons, one on each side at the break of the poop. The guns on the main deck should be in slightly projecting sponsons. The rig should be that of a three-masted fore-topsail schooner, providing a plain sail area of about 6,000 square feet. The total weight of the steam machinery and all its appurtenances, including water in boilers and condensers, all fittings, tools, spare machinery and stores, should not exceed 356 tons.

For the light gunboat of about 800 tons displacement, costing, exclusive of armament, not more than $275,000, we recommend the construction of a single screw composite gun vessel, of which the principal features should conform to the following conditions:

Length on water-line from forward side of the stem to the after side of the stern-post, 165 feet; breadth of beam extreme, 31 feet; mean load draft of water, extreme, 11 feet 9 inches; displacement at load draft, 870 tons; freeboard, about 5 feet 3 inches. The speed over the measured mile on trial, under conditions similar to those prescribed in the Department's General Order, No. 314, should be 12 knots per hour. The main battery should consist of four 6-inch breech-loading high-power rifled guns, mounted on central-pivot carriage in sponsons and on platforms slightly raised above the main deck, each gun-screw to be protected by a light shield attached to the carriage.

## LITERATURE.

*Notes on Chemistry of Iron.* By MAGNUS TROILUS, E. M. John Wiley & Sons, Publishers N. Y. 1885. 8vo. pp. 97. Price. $2.00.

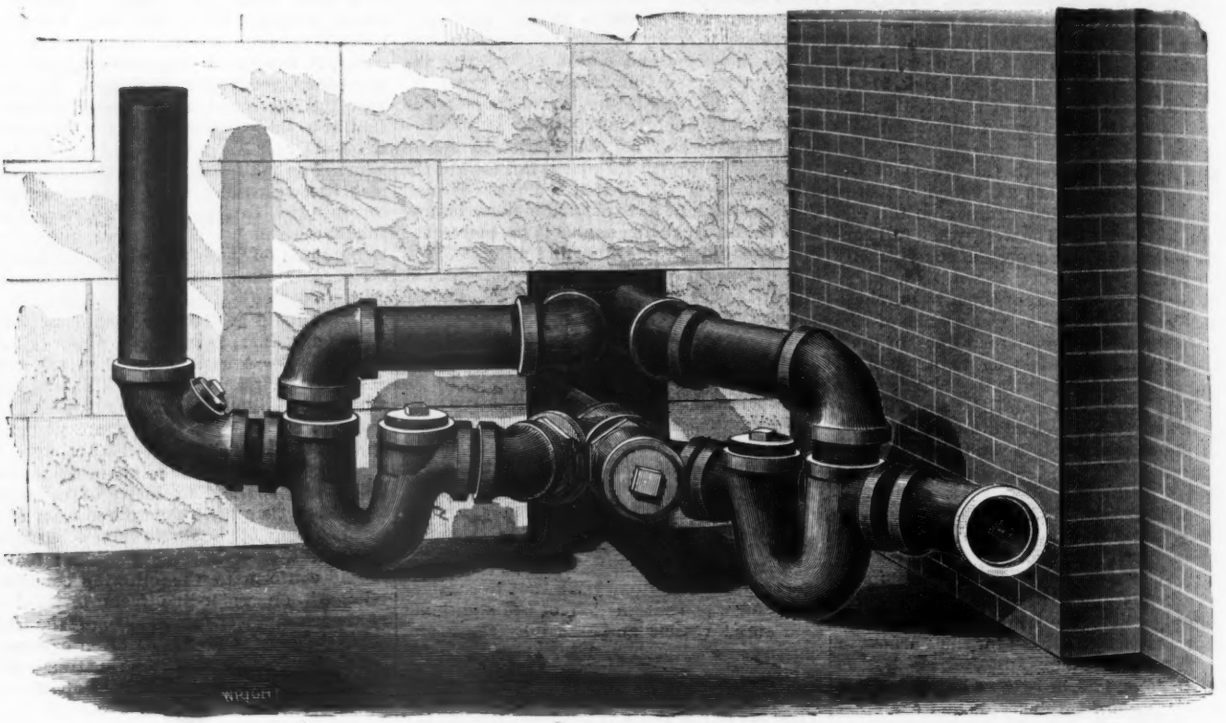
This work is devoted to the explanation in plain language and practical form of the chemical methods of analysis in use in the manufacture of iron and steel. In the various divisions of the book the author treats of the distinctive properties of pig, wrought-iron and steel and the influence of the various elements usually combined with them: the determination of the most important ingredients entering into iron ores, slags, limestone, fuel, etc., and notes on gas analysis. These notes result from actual practice and long experience, and illustrations are used wherever they will assist in the better understanding of the text. In plan it is thoroughly practical, without any unnecessary use of chemical symbols or formulæ; although a certain knowledge of chemistry is, of course, required for intelligent use.

*Lectures on the Principles of House Drainage.* delivered before the Suffolk District Medical Society, the Boston Society of Architects and the Mass. Institute of Technology. By J. PICKERING PUTNAM, Architect. Ticknor & Co., Boston, 1885. sm. 8vo. pp. 125 Price 75 cents.

The selectures are delivered from an architect's standpoint and the prevailing evils in plumbing work are well pointed out and illustrated by wood cuts. We must remark, however, that the almost universal remedy suggested in each case discussed is the use of the "Sanitas" appliances; and while the fixtures so-called seem to possess many points of excellence, the name has a suspicious prominence in a general artical on house drainage.

*Architectural Studies. Part II. Store Fronts and Interior Details.* Edited by F. A. WRIGHT, Architect. Published by Wm. T. Comstock, N. Y. Price $1.00.

This is part II of a proposed series. The 12 plates and descriptive text are devoted entirely to Shop Fronts and interior details of shops. The designs are generally very good; several of them excellent in their method of treatment of troublesome features. They should be useful to architects as they are full of good points.



SEWER CONNECTION, NEW YORK CANCER HOSPITAL.

### Sewer Connect on New York Cancer Hospital.

The drainage of the New York Cancer Hospital now being erected by the Durham House Drainage Co. of New York, from the plans of C. W. Durham, C. E., is a notable illustration of the great advance made in scientific drainage construction within a few years.

The drainage of the hospital is divided into two systems, connected at the point of exit from the building. The illustration shows the junction of the systems, each being separately trapped and ventilated. From the traps the drains rise to the ceiling and are everywhere carried overhead. The main drains are 5 inches diameter, branching into a 6 inch pipe leading to the sewer, 115 feet distant. The air-inlet pipes from the traps, 5 inches diameter, pass out directly over the sewer pipe, and run to the curb, 50 feet distant, terminating in a cast-iron box with grated cover.

The work shown in the illustration was screwed together in the shop and taken to the building as one piece. It serves as a base upon which to erect the two divergent systems aggregating 3,000 feet of pipe.

The screw plug directly at the end of the sewer pipe gives ready access for cleaning purposes. The sewer pipe itself will be as straight and true as a gun barrel. All of the pipe used will be standard steam pipe, and all joints *screw* joints. All material will be treated by the Bower-Barff process for protection against rust. The entire work will be in plain sight at all points,—nothing being hidden or covered.

The entire basement of the building, 9 feet high, is used as a fresh, warm-air chamber, containing nothing but heating apparatus and drainage pipes. The necessity for using the screw-jointed system was therefore quite obvious.

The hospital is principally the gift of Mr. John J. Astor. Mr. C. C. Haight is the architect. It is intended to be as perfect in its appointments as money and knowledge can make it.

The cost of the drainage will be about $3,700.

ENGINEERING NEWS Three months for One Dollar.

### The Proposed Gimplow Tunnel.

The large deflection of traffic from Mount Cenis and French lines generally caused by the opening of the line through the St. Gothard Tunnel has, as our readers will know, made the construction of another tunnel through the Gimplow, a vital question for the French and Eastern Swiss Railway Companies. A new project for this tunnel has been submitted by the Societé Cail to the syndicate of the interested companies, according to which the mountain would be perforated at a great altitude, the length of tunnel being only 4,800 metres. The tunnel is approached at each end by inclines, on each of which a composite platform truck circulates. The complete train is run upon this platform truck at one end of the incline, and deposited at the other end. The line is shorter on this plan than with the projected long tunnel at a less altitude, and there would be no transshipment of goods. The platform truck is composed of rigid transversal frames of varying height, so that their upper surface forms a horizontal platform upon which the train can be run. Each frame is carried by two balance beams, with a certain amount of flexibility and rests on the axleboxes of four wheels. The maximum length of the train has been assumed at 70 metres, and its weight, exclusive of locomotive and tender, at 150 tons. On arrival at the bottom of the ascending incline, the engine would be detached and the train run upon the platform truck, which would then be propelled to the top of the incline where another engine would be attached to draw the train through the tunnel and deposit it on the platform truck at the other side. For drawing the platform, the same system is adopted which has been employed on greater lengths of river for towing boats. A cable fixed at its extremity rests on the permanent way, and is picked up and deposited by a winding drum, round which it passes, the drum being driven by an engine and gearing carried by the platform truck. Westinghouse compressed air brakes are fitted to the latter, but would only be used in case of a breakage of the chain or the gearing, or of an axle, to stop the truck immediately. It is calculated that by these means twenty-two ascending and descending trains could be passed through the tunnel in twenty-four hours, while by dividing the inclines into two portions with a platform on each division and a station in the middle, the number of trains could be doubled.—*London Mechanical World.*

## THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.; M. INST. C. E.

(CONTINUED FROM PAGE 237)

DCCLXXXVII.—TERRELL, TEXAS.

Terrell, Kaufman Co., Texas in lat. 32° 46′ N., long. 96° 10′ W., is at the head of a small valley on the dividing ground between Trinity and Sabine Rivers. The surrounding country is slightly undulating prairie.

Water-works were built in 1883-4 by the city after plans of G.C. Heron, C. E., and under the direction of M. T. Brown, taking the supply from ground water. During the construction of the works they were sold by the City Council to M. T. Brown who now controls them.

From a well the water is pumped by two Worthington duplex pumps of 14-inch steam and 8½-inch water cylinders and 10-inch stroke having a daily capacity of 500,000 gallons, each lifting 120 feet to a wrought-iron tank 10 feet in diameter and 75 feet high. By direct pumping a fire-pressure of 120 lbs. is furnished. Distribution is by 2¼ miles of Kalameined wrought-iron pipe of 10 to 4 in. diameter with 32 fire hydrants.

No meters are used.

The works have cost $35,000. The population in 1880 was 2,003 and is now said to be 4,200. M. T. Brown is the owner and manager of the works.

DCCLXXXVIII.—WINFIELD, KAN.

Winfield, Kansas, in lat. 37° 15′ N., long. 97° W., the county seat of Cowley Co., is on Walnut River, Settled in 1870, it was incorporated a city in 1875. Water-works were built in 1883 by a private company after plans of D. McN. Stauffer, C. E., taking the supply from the river. The water is conducted from a large crib in the river in a 12-inch cast-iron

pipe to a Worthington steam pump having a capacity of 1,000,000 gallons, lifting 110 feet to a masonry reservoir, the walls of which are 8 feet thick at the base, 4 feet thick at the top and 10 feet high, holding 2,500,000 gallons, and being one mile distant from the pump.

For fire pressure the pumps deliver directly into the mains. Distribution is by 7 miles of cast-iron pipe of 12-4 inches diameter with 42 fire-hydrants, 30 gates, 7 meters and 213 taps. Service pipes are of black and galvanized iron. The city pays $75 yearly for the use of each hydrant. The capital stock of the company is $150,000. The cost of the works has been $75,000. The bonded debt is $50,000 at 6 per cent. The expenses for 1884 were for extensions $1,500, for maintenance and operation $1,200, and for interest $3,000. The receipts were, from water rates $3,000, and from the city $3,250. The population in 1880 was 2,844, and is now said to be 5,000. M. L. Robinson is President, and D. L. Koetsinger, Superintendent.

Ram 'em in.
Jam 'em in.
Push 'em in pack.
Hustle 'em.
Jostle 'em.
Poke in the back.
Tramp on 'em.
Stamp on 'em,
Make their bones crack.
Fat woman,
Slat woman,
Tom, Dick and Jack.
Hang on, and
Cling on,
By teeth or by hair.
Hey there!
Now stay there,
And pass up yer fare.

*Courier Journal.*

## WATER

SALEM, IND., has voted to have water-works.

THE Wahpeton, Dak., water-works, were tested Oct. 17, with satisfactory results. The pressure was from 109 to 110 pounds, and five streams simultaneously reached about 100 feet high. Col. Davenport was the contractor.

A MEMBER of the town council of Sterling, Neb., has been in Lincoln investigating the question of water works. He went home firm in the belief that a system of water works suitable for a town the size of Sterling could be put in for about $3,500.

PASSAIC, N. J.—The Citizens' Improvement Association is considering the offer of a New York Company, which has proposed to build an entire system of sewerage in the city, allowing ten years for payment, or renting them to the city at $13,200 per year.

THE Long Island Water Gas Company has been incorporated. The incorporators are Michael Bennett, Thomas Greer, Platt S. Conkling, William Curry and Byron Sloper. The object of the company is to manufacture water gas and apparatus on Long Island.

DOWAGIAC and Monroe, Michigan, have voted to build water-works.

SYRACUSE, N. Y.—On October 9th Mr. Howard Soule, Examining Engineer, made a report to the Syracuse Water Company, on sources of supply, including the Onondaga and Butternut Creek Valleys, and Skaneateles, Otisco, Cazenovia, Oneida, and Tully Lakes.

MR. WAGNER has surveyed the streets of DeSoto, Ga., for the purpose of ascertaining the cost for laying the water mains there provided the annexation bill is carried. This was done at the request of citizens of Rome and DeSoto, as the cost of this work will have something to do with the way a number will vote.

THE new reservoir being built by the Warsaw, Wy., water-works company, is to be twenty times the capacity of the old one. It is the intention to build others, giving a capacity sufficient for three months supply of water. The increased demand makes necessary a larger supply of water as well as storage.

MADISON, WIS., Oct. 10.—During the past summer a water tower has been erected at the State hospital for the insane. It is 62 feet in height, 30 feet in diameter, 18½ feet in depth and will hold 3,000 barrels of water.

THE Nashville Board of Public Works recently engaged an engineer to test the material for the water-works before shipment. He condemned some of the piping furnished by a Camden, N. J., firm, and their agent now seeks to prove that the objections raised were trifling and not worthy of consideration.

SAVANNA, ILL.—Proposals will be received by the city of Savanna, Ill., October 27, 1885, for erecting a system of water-works having a capacity of 600,000 gallons every 24 hours. Proposals should be addressed to A. C. Holland, the City Clerk, and marked "Proposals for Water-works."

To remove eel grass from sluices, race ways and narrow canals get a heavy chain long enough to reach across the canals, and rest slack on the bottom and sides, hitch a horse to each end, and drag it forwards and backwards; the chain will tear up the weeds, which floating off, can be gathered up.

THERE are about 350 meters in use in Jersey City. The manufacturers of the principal meters used will not repair them, and the cost of repairing meters is a heavy item to the city. A 3-inch meter, such as is generally used, costs $150, and from $70 to $80 to set it while the repairs run from $25 to $150, according to the parts worn out or broken.

THE objectionable water proposed for the supply of Huntingdon, Pa., as mentioned in the last issue of ENGINEERING NEWS, seems to be chiefly objectionable because Peter Herdic is to furnish it. According to the Williamsport *Gazette and Bulletin*, of Oct. 18th, a rival company, which wants twice as much money for the privilege of supplying water as does Mr. Herdic, is trying to buy him out. The *Gazette* remarks that in case such purchase was consumated the water would probably be found good enough for all purposes.

AT Wallingford, Connecticut. Engineer Weed's estimate of the cost of a proper sewerage on the west side of the borough, was read October 12th. One plan contemplated the expenditure of $65,000; the other about $10,000 less. The report is an exhaustive one, giving in detail what would be required and the cost thereof. The sum needed was much greater than had been expected. A resolution empowering the board of burgesses to find out the cost of making an accurate and perfect map of the borough with reference to sewage was passed. A Committee was chosen to report upon the best and most equitable way of paying for the cost of sewering, and to advise what, if any, amendments are needed to the charter of the borough to carry out the most approved and desirable plan of sewering the borough or any part of it. This committee will report at a meeting to be held at the town hall Saturday evening, October 31.

FROM an official source we find that the full text of the proposition made to the City of Philadelphia by the South Mountain Water Company—whose organization we have already given—is as follows:

It asks from the city a lease for fifty years or the entire existing plant, and offers in consideration for this, $5,000,000 to be expended in completing the city reservoirs, laying new mains and replacing old pipe, $2,000 to be payable within sixty days from the delivery of said lease, and $3,000,000 in equal semi-annual enstalments of $600,000 each; in addition to this, a sum of $3,000,000, to be paid to the city within ninety days from the delivery of the lease, for its own use for such municipal purposes as it may see fit. The company is to construct within two and a half years, a new conduit from a point near Point Pleasant, on the Delaware River, to some point within the city limits; the conduit to deliver not less than 200,000,000 daily, and as estimated by Col. Wm. Ludlow, to cost $8,000,000. The necessary dams at Tohickon and Mill Creek, and the land damages are estimated to cost $2,000,000 more, or a total of $10,000,000 for conduit, dams and right-of-way. The company is to retain the gross receipts from water rents, until these receipts exceed $2,000,000 annually; then they are to pay into the City Treasury one-half of the excess above this amount.

ASBURY PARK, N. J.—The Water Commissioners have decided to sink wells on the turnpike between Key East and the head of Wesley Lake; the contractors are Messrs. Kisner, Bennett & Co.

THE expenditures on the new aqueduct to date have been $1,735,948. A new shaft is to be constructed near the city of Yonkers. About five miles of tunnel are already completed, including open cuts and 1,500 feet of brick work.

PROVIDENCE, R. I.—The Board of Aldermen have passed resolutions adopting the plan of City Engineer Gray for disposing of the sewage, and authorizing application to the Legislature for authority to condemn land for right of way.

BIG RAPIDS, MICH., October 14th.—At an election today on the water-works question a two-thirds vote of the city was polled. A majority of 180 for $35,000 to change the water system resulted.

BUFFALO, Oct. 17.—Mayor Harrison, Water Commissioner and the heads of the Municipal Departments of Chicago, arrived here this afternoon to inspect the water-works of this city, with a view to contracting for the engines needed in Chicago. They were shown about the city by the Water Commissioners.

LOCKPORT, N. Y., Oct. 18.—Carter Harrison, Mayor of Chicago, with several officials of that city, arrived here yesterday by special train for the purpose of making a personal examination of the Holly Water Works Manufactory, with a view of procuring a system or plant of their works. The examination was satisfactory, and a contract for a set of works at a cost of $100,000 was agreed upon. The party had examined on their way east, works built and now in actual use in other cities.

NEW LONDON, CONN.—A city meeting was held September, 28th, to vote on the issuing of bonds to carry out the construction of intercepting sewers. By a unanimous vote it was decided that bonds should be issued and the sewers built. The vote calls for $35,000 in bonds to meet the cost of constructing 8,625 lineal feet of intercepting sewers. The cost of completing the sewerage system is put at $65,000 additional, making the total cost, $100,000. Mr. Rudolph Hering is Consulting Engineer.

THE extension of the Middleboro, Mass., sewer is liable to make trouble. The Taunton Water Commissioners say that it is contaminating the water supply. Dr. Abbott of the State of Board of Health, Superintendent Billings of the Taunton Water Works and Dr. Presby of the Taunton Water Commission recently examined the plans of the sewer. Dr. Abbott admitted that the Star Mills Woollen factory, in Middleboro, was now polluting the stream more than the sewer could. He said he could do nothing until Taunton makes a formal complaint.

MINERVA, O.—The following bids for water-works complete, including pump, supply-well, boiler-house, tank, water-mains, etc., were received by the Water-works Trustees, October 6: L. B. Stanley, Collingwood, O., $8,964.50; Pennock Bros., Minerva, O., $10,670; W. S. Parker, High Bridge, New York City, $11,550; Andrews, Doolittle & Safford, Cleveland, O., $11,659.89;—Chisholm, East Liverpool, O., $11,866; J. H. Harlow, Pittsburg, Pa., $11,478; Fairbanks, Morse & Co., Cleveland and Chicago, wood pipes, $10,200, cast iron pipes, $11,200; Patterson & Baldwin, Pittsburg, $11,300. The contract has not yet been awarded. Bonds will be sold on October 27. The law of the State is such that the money must be in the treasury before the contract be awarded

THIRTY miles of pipe will soon be ready for use to convey natural gas from wells located near Sheffield, Warren county, Pa., to Jamestown, Chautauqua county, N. Y. The pipe is mainly eight-inch pipe, though a part of it is still larger, laid in a trench about two feet deep. Thirty-five miles of smaller service-pipe have been laid in the streets of Jamestown, and it is expected by November 1, to supply gas as desired at that place for manufacturing and domestic purposes. Gasometers are constructed for the purpose of receiving the gas and regulating the pressure. It is expected that the initial force at the point of supply will be sufficient for the delivery of the gas, without mechanical assistance, thirty miles distant. The cost of the Jamestown plant is estimated not to exceed two hundred thousand dollars.

THE Utica Water-Works Company is laying a 20-inch main in Genessee street. This is part of a two-mile extension with 24 and 20-inch pipe. The 24-inch pipe is from the Warren Foundry and Machine Company, and the 20-inch-pipe from R. D. Wood and Co. There is one 24 inch and three 20-inch valves on the line of the main, all from Ludlow Valve Company.

The same company is building a large storage reservoir after the plans of C. F. Carpenter, C. E. The embankment is of earth, with a puddle core; the maximum height is 60 feet, with inner and outer slopes, 2 to 1, the top width is 20 feet, and length 1,940 feet. The area flowed is about 60 acres, and the completed capacity 500,000,000 gallons.

All the above work is being done by the company by day's labor. No contracts are let.

THE citizens of Anderson, Madison County, Ind., have voted to have water-works.

MAYOR TIMKEN of Hoboken, has affixed his signature to the ordinance passed by the Hoboken Common Council giving the Mutual Benefit Gas Co., permission to lay pipe, erect works, &c. Secretary McCague, of the new Gas Company, states that work will be commenced forthwith.

THE artesian well at the railroad depot at Americus, Ga., has a flow of about 80 gallons to the minute at the surface, but it cannot be forced up high enough in piping to flow into a tank. The railroad authorities will put in a hydraulic ram a few feet below the well, which will force the water into the tank.

G. F. NEWTON, superintendent of buildings and bridges on the Union Pacific road, has left a proposition with Water Commissioner Lyman, of Lincoln, Neb., to take city water for the use of the company for all purposes in this city. The water commissioner will submit the proposition to the council at its next meeting.

THE syndicate, known as the South Mountain Water Company, and organized to lease the Philadelphia Water-works and bring in a new supply from the Delaware River, was organized formally on October 14. The directors are: John M. Maris, dealer in druggist's sundries; Jos. I Keefe, director Union Trust Company; Jas. Long, President Union Trust Company; S. P. M. Tasker, of Morris & Tasker; B. K. Jamison, banker, and Richard Garsed, yarn manufacturer. John M. Maris is President of the syndicate. No further particulars are given save that they can get all the capital they want from England if the city should accept their proposition.

THE Greely Electric Light Company, Greely, Colo are about to put in a plant of 600 Brush incandescent lights, and have placed their entire contract for steam and motive power with the Pond Engineering Co. of St. Louis.

The order includes two 42 horse power Annington and Sims engines, two 50 horse power steel boilers, one Lowe feed water heater and one Blake boiler feed pump of 100 horse power capacity each. Also foundation boxes, belting, etc. The Pond Engineering Co., are making a specialty of fitting up electric light stations, and report numerous orders on their books.

THE Carrollton, Mo., water works were successfully tested October 8. The water is pumped from wells in a gravel bed by four Gaskill engines, acting independently of each other, with a nominal capacity of 1,500,000 gallons in 24 hours, they were built by the Holly Manufacturing Co. The pipes are of cast iron, 4, 6, 8 and 10 inches diameter. At the test the water was forced to a height of 175 feet. The president of the company is B. F. Jones; Secretary, E. L. Martin; Treasurer, F. Wing; Mr. J. L. Mitchell was the superintendent and engineer, but resigned in a few months owing to ill health, and the rest of the work was done under the charge of Mr. Wing. Mr. Hamilton will now be superintendent and engineer of the works.

THE Beloit, Wisconsin, water-works are approaching completion. The well is 30 feet diameter, and 40 feet deep, and was tested to 3,500,000 gallons in 24 hours. There are two compound duplex pumps by Smith Vale, Dayton, Ohio, the capacity of each is 1,000,000 gallons. Steam is supplied by two steel boilers. A tank holding 100,000 gallons is built on a stone tower 63 feet high, diameter inside 21 feet, outside (top) 29 feet, (bottom) 36 feet. Pressure 50 pounds per square inch in the city. There are 7¼ miles of pipe from 4-inch to 14-inch diameter, and 72 Mathews fire hydrants. Works constructed by Fairbanks, Morse & Co. Chicago; pipe laid by C. E. Gray; tank erected by Eclipse Wind Engine Company. Beloit. J. B. Peet is President of the company; C. B. Salmon, Secretary; J. R. Kinley, Engineer; and W. H. Fritchman, acting Superintendent.

FIRST WATER SUPPLY.—We read that the first introduction of water supply into houses by pipes under pressure was in connection with the London Bridge Water Works, established in 1582. The earliest water-mains were of lead or wood, but it was not until cast-iron came into use for this purpose, about 1810, that the water supply of towns began to receive its full development. The introduction of pumping machinery for domestic water supply, dates from May 30, 1581, when Peter Maurice was granted a lease to erect an engine within the first arch of London Bridge, for the purpose of supplying that city with water. These works proved so successful that he was granted the privilege of erecting another engine in the second arch of the bridge. His pumping machinery consisted of an undershot wheel, 20 feet in diameter, having 26 floats, 14 feet long by 18 inches broad. Each wheel gave motion, by means of toothed wheels and levers, to 16 pumps, in such a manner that for every revolution the plungers made two and one-fifth strokes 2 feet 6 inches long. The plungers were 7 inches diameter, and when the tide flowed quickly the water-wheels made about six revolutions per minute. Making no allowance for "slip," the two wheels would together be thus pumping at the rate of about 2,500,000 gallons in 24 hours.

ROCHESTER, N. Y., having failed to pay a judgment for $95,000 damages decreed against the executive board, has been enjoined from drawing water from Hemlock lake, the sole source of supply.

FIFTEEN Italian laborers employed by the Crystal Water Company at Edgewater, S. I., were arrested Oct. 16, by George H. Daly, Trustee of the First Ward of that town, for digging up the streets. The Crystal Water Company had a contract to supply the town with water, and had partly fulfilled their agreement when the town officers declared the contract broken on the part of the water company for non-performance of its agreement.

WORK on the St. Cloud, Minn., dam is progressing rapidly. The crib to protect the mouth of the canal is being put in and the tail race outlet from the canal to the river is being dug. On the east side the pile driving for the abutment and wing to protect the lower bank from eddies is about completed. Most of the piles have been sawed off under water, and the timbers for the east abutment are being put in place. About 80 men and a dozen teams are employed on the work constantly.

COLONEL LUDLOW, of the Philadelphia Water Department, stated that as far as he knew there was not at present a case of violation of the resolution of Councils forbidding the pollution of the waters of the Schuylkill. The three test suits had settled the matter, and the others had acquiesced. Despite this, however, he admitted that the water was but little purer than it was a year ago, owing to the drainage of the mills, which was really a violation of the last part of the act of February 7, 1882.

AFTER several years of digging and waiting, Hope, Ark., has an abundant supply of pure water. The well has been in progress for three years, and is 1,100 feet deep. The contractors struck water at 400 feet, and finally concluded to rely upon that vein for supply. They put down iron piping for one hundred and twenty feet, purchased a pump, a twelve-horse power engine, and everything needful for supplying the town. The works are under the management of Mr. Darley, the city engineer. A large reservoir has been constructed, and four hundred feet of water-pipe laid.

THE Frankfort, Ky., water-works, have been opened. The Holly Engine company have put in an engine of 2,000,000 gallons daily capacity. The two reservoir basins are 140 feet by 116 feet at the bottom, and 20 feet deep: their capacity is 5,000,000 gallons; the contractors for the reservoir are W. F. Shanks, and J. Jamison of Louisville. The pressure will be from 100 to 115 pounds. The company is composed of Samuel Miller, of the firm of Dennis Long & Co., Louisville, Ky., President; Col. Stoddard Johnston, vice-President; Wm. Reinecke, Secretary; and the President, C. R. Barrett, G. Long, and Gen. D. W. Lindsey, Directors. Chas. Hermany, of the Louisville Water Co., is chief engineer, and Webster Guzlay in charge of construction.

THE Gadsen, Ala., water-works are being constructed by the Manhattan Construction company, of New York, and are nearly finished. Henry M. Fuller is the superintendent in charge, and Robert E. Hardaway the engineer. The capital stock of the company is $60,000, nearly all of which is Northern. The city takes fifty hydrants at an annual rental of $75 each, or $3,750 per year, for all. The water is to be obtained from the Coosa river, from whence it is pumped through 2,000 feet of pipe to a reservoir 200 feet higher than the river and 137 feet higher than the city. The reservoir is 128 by 190 feet at the top, 38 by 98 at the bottom, and 18 feet deep. Considerable difficulty has been met with, on account of rock in digging the reservoir.

## NEWS OF THE WEEK.

### Contracting.

**Water-works.**—The contract to build the Cairo, Ill., water-works stand-pipe system has been let to Peter Herdic, of Williamsport, Pa.

**Iron Roofs.** The Marshall Foundry and Construction Company, of Pittsburg, Pa., has received the contract for the iron work of roofs, etc., of the public building at Peoria, Ill., at its bid of $1,261.12.

**Water Pipe.**—The Troy, New York, Water Commissioners have awarded the contract for furnishing 12-in. water-pipe to R. D. Wood & Co., of Philadelphia at $29.50 per ton.

**Gas Works.**—The contract for building the gas works at Cottage City, Mass., has been let to Burdett Loomis of Hartford. The contract includes a brick building with an iron roof, 25,000 feet of piping in the streets, and all necessary plant.

**Bridge Contracts.** Colonel B. M. Temple and Captain Fred Harris, civil engineers and bridge contractors, have secured the contract for the erection of two wrought-iron bridges on the Lampasas extension of the Gulf, Colorado & Sante Fe railroad, near Brownwood, Texas.

**Court House.**—J. B. Patton, contractor, of Rome, Ga., has been awarded the contract for building the new court house at Jacksonville, Alabama.

**Government Work.**—WASHINGTON, October 15.—Bids were opened at the Treasury department to-day for brick and stone work on the new Federal building at Lynchburg, Va. A. M. McGowan, of Washington, was the lowest bidder at $25,700.

**Water Works Awarded.**—CRAWFORDSVILLE, Ind.—The City Council has given the contract for water works to E. B. Martindale, Indianapolis. The works must be finished in one year, the contractor to furnish six drinking-fountains free of cost to the city. He also agrees to furnish churches and school buildings with water without cost; 125 hydrants are to be furnished, for which the city agrees to pay $5,000 per annum, additional hydrants to be furnished at $35 a year.

**Government Work.**—COASTERS' HARBOR ISLAND, R. I.—The following awards of contracts have been made. Building reservoir to T. M. Harris, at $5,937; water-pipe and trenching to J. M. Symington, at $3,223; pumping-engine to Murphy & Carroll, at $600; pumping-house to Peter Knowe, at $655; painting to William Austin, at $625. No award has been made for sea-wall, owing to inadequacy of the appropriation. Modified specifications are being prepared for re-advertisement.

**Dredging at Flood Rock, N. Y.**—Col. Walter McFarland opened bids on October 21, for dredging at Flood Rock in the East River. The basis of work to be done at this letting is 30,000 tons, and the following bids are by the ton of rock; the sum available for this work at present, is about $175,000:—

| | | | | |
|---|---|---|---|---|
| American Dredging Co., Phila. | $3.90 | per | ton, | or $117,000 |
| P. Sanford Ross, Jersey City | 3.48 | " | " | 104,400 |
| Harbor Imp. Co., New York | 3.49 | " | " | 104,700 |
| Morris & Cummings, New York, | 3.38 | " | " | 101,400 |
| Atlantic Dredging Co., Brooklyn, | 3.19 | " | " | 95,700 |

**The Globe Woollen Co., of Utica, N. Y.**, are about to build a worsted mill. The structure is to be of brick 4 stories high, 204 feet long, 60 feet 6 inches wide, with tower, engine, and boiler room. Chimney 120 feet high 13 feet 2 inches square at base, battering 1 inch in 3 feet, containing 200,000 bricks above water table. Bids for the brick work are advertised for up to the October 23d, 1885. The company furnishes the foundation complete and all materials except scaffolding and planks for runways. The architect is A. J. Simmons, Room 15, Garden Block, Utica, N. Y.

**Bids Received.**—At a meeting of the N. Y. Park Commissioners on the 21st, bids were received for excavating and removing earth and rock, furnishing the material and completing the drainage, furnishing the material and erecting the mason work, granite and other stone work of the enlargement of the Metropolitan Museum of Art in Central Park—the whole in accordance with the plans and specifications for this work. Following are the bids: Lane & Armstrong, $159,444; Michael Gillin, $145,000; E. D. Conolly & Sons, $177,000; John Cox & Co., $162,500; Jeremiah C. Lyons, $137,700; John and Louis Weber, $168,500; James H. Brady, $165,280.

**Rip-Rap.**—At the office of Lieut. Col. George H. Elliot, United States Engineer, October 17, the following bids were opened for supplying rip-rap granite for the eastern jetty at Nantucket, Mass., and for putting the granite in position:

| *Name.* | *Per Ton, 2240 lbs.* |
|---|---|
| C. H. Edwards, Quincy, Mass | $1 96 |
| John E. Bowker, Jersey City, N. J. | 2 37 |
| W. H. Molthrop & Co., New London, Conn. | 2 47 |
| James Scully, Groton, Conn | 2 50 |
| James V. Luce, East Lyme, Conn | 2 78 |

Colonel Elliot has recommended that the bid of Mr. Edwards be accepted after the usual sureties are given.

**Work Done on the Washington, D. C., Water-works Tunnel.**—Following is a statement of work done on the Washington, D. C. Aqueduct tunnel up to date (October 15th): Foundry branch West heading (which has been completed) 2,418 feet have been excavated; East heading 2,423 feet. Rock Creek Shaft, west heading 3,138 feet; East heading 2,926 feet. Champlain Avenue Shaft, West heading 1,928 feet; East heading, 1,892, Howard University 1,783 feet. Making a total of 16,508 feet completed, leaving 4,207 feet yet to be excavated. The Ingersoll "Eclipse" Drills used in driving the tunnel are doing excellent service and the whole work is progressing in a most satisfactory manner.

**Trouble on the Canadian Pacific Railway.**—MONTREAL, October 16.—War has at last been declared between the contractors and the C. P. Railway and the disputed overpayments on the section north of Lake Superior will probably soon be brought to light. The Company having refused to pay the claims of the contractors, they have entered actions aggregating $1,000,000 against the Company. The largest claim is that of John J. McRae, who had contracts on three of the sections, and is suing for $200,000. James Barry, another contractor, sues for $150,000. A third suit for $200,000 has been entered before the Ontario courts. The Company in the majority of the cases claim they have been victimized by the contractors co-operating with the engineers. The contractors pretend they have nothing to fear, and they say want of funds is the reason the claims are not settled.

**State House Contracts.**—TOPEKA, KAN., October 13.—The State commissioners to-day awarded contracts as follows: plastering of the Senate chamber, story of the east wing, to Joseph Eastman, of Chicago, for $7,310; building the basement story of the main building, two lower courses to be of granite, to James Culpert, of Topeka for $29,599.50.

**Road Grading.**—The "New Era" Road Graders are now doing considerable work in Minnesota and Dakota, and are in great favor with the landowners, as the work is done more rapidly and efficiently than by plows and scrapers. In Pembina Co. Dak., the machine built fifteen miles of road in thirty-two days: road 28 feet between the ditches, which were 9 feet wide and from 1½ to 2 feet deep; the total cost for labor was about $5.42 per mile. It has been shown in Minnesota that roads can be built for $22 per mile, and great saving has been effected on bad pieces of road. The makers claim the machine can make ¼ mile of good road per day, but this has been exceeded in many cases.

**Street Paving by Tramway Cos. in Philadelphia.**—At a meeting of the committee on highways, of the Philadelphia Councils, on Oct. 20, Mr. Kemble, the President of the Traction Company, and other street railway officials appeared. Mr. Kemble promised for his company, to lay 40,000 square yards of Belgian block pavement next year, on the line of his road, and a similar quantity each succeeding year. The city was to pay his company $1.35 per square yard, the railway company to pay all other expenses. President Fox, of the Second and Third streets Passenger Railroad Company, offered to lay the Belgian pavement on the line of his road, if the property-owners on the streets would furnish the blocks. Capt. F. V. Greene, U. S. A., gave the committee his views on the improved plans in street railways adopted in England; he described the system of grooved rails laid on concrete base with longitudinal sleepers. Capt. Greene stated that these roads were only renewed once in thirty years; he recommended Belgian block pavement.

## Railroads, Bridges and Canals.

**The Silver Springs, Ocala and Gulf Railroad** will be extended to Gainesville in the near future.

**Louisville Southern Railroad.**—It is proposed to build this road from Louisville to Danville, Ky.

**New Kansas Road.**—A new railroad will soon be built from Leavenworth, Kansas, to Olathe.

**The Central Massachusetts Road** beyond Hudson is progressing rapidly.

**The Omaha Railroad** will be extended from Ellsworth to Red Wing, Nebraska, as soon as the frost is out of the ground in the spring.

**The Richmond and Danville system** will soon commence the construction of a line of road between Millen, Ga., and Harts Road, Fla., where the line will connect with the Florida Railway and Navigation Company.

**A Colorado Line.**—Hon. C. Barella of Las Animas, Colorado, proposes to build a railroad five miles long between Trinidad and El Moro, and have it in operation within sixty days.

**The Marshall and Northwestern Railroad** intends to build a line from Marshall, Texas, northwest to an intersection with the St. Louis and San Francisco Road in the Indian Territory.

**Iron Bridge,**—The Grand Rapids, Michigan, Board of Public Works will receive bids for the building of the new iron bridge at Sixth street until December 1, and the contract will be let early next season.

**Fifty-four Ton Gun.**—A successful attempt was made October 16, to cast the 54-ton 12-inch breech loading rifle for the United States Government at the South Boston Iron Works. Over 105 tons of metal were used.

**Cincinnati, Hamilton & Dayton** officials are talking of taking hold of the Dayton & Ironton narrow gauge, widening it to a standard gauge and making it a part of the Cincinnati, Hamilton & Dayton system.

**A. T. & S. F. R. R.**—The Santa Fe road will extend its line about fifteen miles beyond Coleman, Texas, and there lay out a town to be called Gresham, which will most likely be the terminus for some time to come.

**C. M. & St. Paul Depot.**—Final estimates have been made regarding the new Milwaukee depot of the Chicago, Milwaukee & St. Paul railway. It is estimated that when completed the structure will have cost $450,000.

**Savannah Valley R. R.**—On the 12th inst., the grading of the entire line of the "Savannah Valley R. R." was finished. Tracklaying going on rapidly; four miles laid from southern terminus at McCormick, S. C. C. S. Dwight is Chief Engineer.

**California Lines.**—There are now in progress in California fourteen railroads, with a total of projected mileage of 604 miles. The most active work during the past six months has been prosecuted on the Atlantic and Pacific extension.

**The Florida Southern Railroad** surveyors are surveying a route for a new road from Brooksville to Tampa.

**Welland Canal.**—The Government engineers have completed plans for the enlargement of the Welland Canal to fourteen-foot draft. The work will cost over $1,000,000, and tenders for carrying it out will at once be called for.

**Georgia Central R. R.**—WRIGHTSVILLE, Ga., October 14.—The railroad has reached Lovett, seven miles below here, in the direction of Dublin. The Central road has the contract for laying the iron, and is pushing forward with energy.

**Northern Pacific Railroad.**—The N. P. R. R. is building a tunnel 460 feet long at St. Paul, Minn., under Westminster St., and the tracks of the Manitoba R. R. The soil is sound, rendering the work very difficult, and hard blue clay has also been met with.

**Change of Gauge.**—E. B. Thomas, the new general manager of the Richmond & Danville road, will urge the directors to make the entire system standard gauge. There are now three divisions broad gauge, 5 feet; two divisions narrow gauge, 3½ feet; the remainder is standard gauge, 4 feet, 8½ inches.

**Persia.**—The Persian government states that it is disposed to offer every facility in its power to improve business relations between Persia and the United States. Any proposals, for concessions for tramways, railways, mines or commercial projects would receive the most serious and favorable consideration.

**Railroad Commenced.**—Ground was broken October 10, on the South Atlanta Railroad, at Bristol, Tenn., to be built from that point to coal fields in southwestern Virginia. The road is to extend from Bristol to Big Stone Gap, Ky., a distance of 65 miles, and will be finished through the Cumberland Mountains in Cincinnati.

**Northwestern of Texas.**—MARSHALL, Tex., October 12.—Messrs. Heartsell and Lloyd, of the Northwestern Railroad left this morning for Paris, Tex., to confer with Scott and Youree, contractors for grading the road from its northwestern terminus to Winnsboro.

**A Proposed New Line in Mexico.**—EL PASO, Tex., October 12.—There is a probability of a narrow gauge railroad being built from the Mexican Central to the Sabinal mines, as the project has found great favor in the leading centers of the City of Mexico.

**The Canadian Pacific Railway**, in the Rockies is progressing rapidly, but has been interfered with by the wretched weather which has prevailed. The track from the east has reached a point 27 miles east of the summit of the Selkirks, 22 miles west of the summit in the Kicking Horse Pass and 2,514 miles west of Montreal. The track from the British Columbia end has reached a point 104 miles east of Kamloops, and 341 miles east of Port Moody, leaving a gap of only 40 miles on which the track has yet to be laid before the last spike is driven by His Excellency the Governor-General.

**New Line to the Gulf.**—Several western cattlemen are moving for a new line to the Gulf. Their plan, which is already being put into execution, is to build a line from Kansas City, Mo., to Abilene, Tex., to connect with the lines running to Aransas Pass, Tex. It is necessary to build about 500 miles of line to make connection between Abilene and Kansas City, and then the road will be an air-line direct to the Gulf of Mexico. From Abilene to San Antonio the Gulf, Colorado and Sante Fe tracks will be used. The line from San Antonio to Aransas Pass, Tex., is now being built, and when this end of the system is constructed Kansas City will have a direct line to the Gulf.

**The Havre de Grace Bridge.**—BALTIMORE, Md., Oct. 12.—Work on the great bridge building across the Susquehanna River at Havre de Grace, Md., on the Philadelphia extension of the Baltimore & Ohio Railroad, is rapidly drawing to a completion. Trains are expected to cross about December 1. The Susquehanna bridge is a Whipple truss, and excepting the west approach viaduct is a single track straight bridge. Its total length is 6,316 feet, its longest spans (520 feet) are only exceeded by two bridges in the world, both American—one on the Cincinnati Southern Railroad across the Ohio which exceeds it by only ten feet, and the other on the Louisville & Nashville Railroad across the Ohio at Henderson, which exceeds it by only seven and a half feet. The metal in this span, all steel, as all the spans are, weighs 800 tons. The steel used is required to have a tensile strength equal to 65,000 pounds per square inch. The rail will be ninety-five feet above the water and the top of the 520-feet through span 160 feet above water. The heaviest single piece of steel weighs twelve tons. The cross-ties used are of the best whiteoak timber, nine inches wide and ten inches deep, with only four inches space between them, so, should a car jump the track, it will roll along over the ties easily without throwing any great strain on the bridge. The trestle-work was done by the Phœnix Iron & Bridge Company and the spans by the Keystone Company of Pittsburg, Pennsylvania.

**The Okeechobee Company's** dredges cut 66,122 cubic yards during last month, and 6,000 lineal feet of canal 8x50.

**Fort Worth & New Orleans R. R.**—Eighteen miles of the Fort Worth & New Orleans railroad are now graded, and the iron and ties all contracted for. The contracts for bridging have been let to Mr. H. H. Harding.

**Canadian Pacific Air Line.**—Several railway contractors are leaving Ottawa for Montreal to look after work on the proposed Canadian Pacific Railway Air Line from Smith's Falls to Lachine. It is rumored that the construction of this work will be shortly commenced.

**Bridge Burned.**—YUMA, ARIZ., Oct. 17.—The new railroad bridge across the Colorado River at this place was totally destroyed by fire this morning. The fire started on the California side of the river. The cause of the fire is unknown. The loss is over $200,000.

**Temiscamingue Railroad.**—OTTAWA, Oct. 15.—The Temiscamingue Colonization Society has decided to call for tenders for building the Long Sault and Temiscamingue Railway. The line has been surveyed, and will be seven miles long and constructed to overcome the rapids at the foot of Lake Temiscamingue.

**Georgia Again.**—The Governor has signed the following bills:

To incorporate the LaGrange, North and South railroad company.

To incorporate the Cincinnati, Georgia and Florida railroad company.

**A Georgia R. R.**—Surveyors have started from Greenville, Ga., to survey a route for a railroad to Newman, Ga., by way of Rocky Mount. When the survey is completed and estimates furnished, it will then be determined whether the extension from Greenville is to be made to Fairburn or Newman.

**The St. L. C. M. & P. R. R. Co.**, has been incorporated. The incorporators are James Millan and Charles H. Appel of St. Louis, and H. W. Hart, Sr., W. E. Smith and L. A. Bosworth of Alton, Ill. The road begins at East St. Louis and runs to a point on the Ohio River opposite the city of Paducah, Ky., most suitable for ferrying or bridging, and is to run near the cities of Vienna and Metropolis.

**St. Cloud & Willmar R. R.**—ST. CLOUD, Oct. 16—D. C. Shephard & Co., contractors for building the St. Cloud & Willmar road to Richmond, Minn., have begun active operations on their work. They have about 100 men now, and will complete their camps next week. Peter Simes is in charge of the work. Foley Bros., of this city, subcontractors for grading seven miles of the line, also have about 100 men at work.

**Kentucky & Indiana Bridge.**—False work will be put up between piers 2, 3, 4, 5, 8, and 9 of the Kentucky and Indiana bridge. The false work has already been put in place between piers 6 and 7, and upon this is the "traveler," which is nearly 200 feet above the water. The distance between piers 5 and 6 is 483 feet, and between 7 and 8 it is 485 feet. The iron and steel superstructure will be placed over these long spans without the assistance of false work.

**The Chautauqua Lake Railroad.**—JAMESTOWN, Oct. 17.—Work was begun to-day on the Chautauqua Lake Railway, which is to be run on the east shore of the lake between Jamestown and Mayville, twenty miles, with the probability of being extended seven miles to Westfield on the Lake Shore Railway. Five hundred men will be employed until the road is finished. The company also contemplates building a mammoth summer hotel at Long Point.

**Minnesota & Northwestern.**—During the summer a survey has been made of the whole line and a definite route located, except on about thirty miles, on which the engineers are now at work. The Company purchased the rails and ties for the whole line to be delivered during the winter. The grading on the Dubuque & Northwestern will be completed in the spring to a junction with the Minnesota & Northwestern Road fifty miles northwest of Dubuque. A large amount of rolling-stock, including 500 freight cars and twenty-five locomotives, has been contracted for to be delivered in July o next year.

**Important Railroad Project.**—A new line to be known as the Kansas, Nebraska & Dakota Railway, is to extend from Fort Scott, Kan., in a northwesterly direction to Bismarck, Dak., crossing Nebraska in an almost straight line. The scheme is backed by Pennsylvania capitalists, and stock is said to have already been subscribed to the amount of $15,000,000. All the lines now in operation run east and west. Fort Scott is connected with Memphis, Tenn., by the Fort Scott & Gulf Railroad. The projected road will connect with that line, and, running north, cross the Burlington at Pawnee City. The road from Fort Scott to Topeka is to be built at once, and the entire line, it is expected, will be completed by January, 1887. It will be a standard gauge, steel-rail line, and will be first-class in every respect. The line from Fort Scott to Topeka will be 120 miles and the distance to Bismarck is 500 miles.

**Savannah to Americus.**—Notice has been given of an application to be made for a charter for a road to be known as the Savannah, Dublin and Western Shore Line Railroad Company, running from Savannah to Americus by way of Dublin and Hawkinsville.

**The Central Pacific Railroad Company** has recently introduced crude petroleum into nearly all its steamers including the Oakland ferry-boats. The oil is obtained in California, some of it at Ventura and some from wells not long struck near Livermore on the line of the Western Pacific Branch. The method of application is practically identical with the Russian—namely, by a steam jet.

**A Large Derrick.**—The largest and strongest derrick in this country will soon be erected at the stone quarry of McDonnell & Sons, in Quincy. The derrick will be 65 feet high and over 30 inches in diameter. Eight steel wire guys, two inches in diameter, will give it support. The guys were purchased in New York, and are some that were left over from the construction of the Brooklyn bridge, when the derrick is in position, it is expected that 100 tons will be easily lifted by it.

**Duluth Improvements.**—C.C. Wrenshall, superintendent of bridges, tracks, etc., for the Northern Pacific, is preparing plans for the improvement of lands recently purchased by the company at Duluth. The improvements are to consist of new docks and warehouses. The docks are to be 1,400 feet long and 300 feet wide. They will be entered by a new slip to be built by the Improvement Company. The Northern Pacific paid $28,000 for the property. The contract for the necessary pile driving has been awarded to Palmer & Co., for $23,000.

**A Great Tunneling Project.**—OTTAWA, ONT., 19.—Experts who were sent to report on the scheme for connecting Prince Edward Island with the mainland by tunneling Northumberland Straits have reported favorably and the work will soon begin. Senator Howland, who orignated the idea, is here making arrangements with the Government for a subsidy. Vernon Smith, a prominent engineer, will superintend the work, in connection with which he will leave immediately for New York to make preliminary arrangements with capitalists of that city who are taking hold of the project.

**The Revival in the Iron Trade.**—READING, PA., Oct 17.—The furnaces and machinery of the steam forge of the Reading Iron Works, which were idle for two years, were to-day inspected by the company's officials with a view of putting them into operation. The forge in brisk times employed 150 men. It is also rumored that the Philadelphia and Reading Company's rolling mill, where the manufacture of iron rails was discontinued several years ago, will be placed in operation after the mill shall have been changed into steel rail works. This mill formerly employed between 200 and 300 hands.

**Telegraph.**—The longest spans of overhead telegraph wire in the world, have recently been put up by the French authorities in Cochin, China. These are erected across the river Mekong, posts 160 feet high having been placed on each side of the river, at a spot where the width is 2,560 feet; and from these silicious bronze wires—one .01 of an inch, and the other .065 of an inch in diameter—are suspended across the stream. Over a tributary of the river another similar connection has been made, 1,670 feet span, and more than 114 feet above flood water. The former of these is a span of .046 of a mile.

**A Chart of Forestry.**—An immense chart exhibiting the areas of improved forest and unimproved land in each state and territory of the Union, prepared by the forestry division of the agricultural department, shows that there are 285,000,000 acres of improved land. 445,000,000 acres of forest, and 730,000,000 acres of unimproved and waste untimbered land. Incidentally it is found that forests are disappearing at the rate of 25,000,000 acres each year. The forest product during the census year was about 18,000,000,000 feet board measure. Last year it was 28,000,000,000 feet.

**A New Canadian Railway.**—OTTAWA, ONT., Oct. 17.—Sir A. T. Galt, will apply to Parliament next season for a charter to construct a railroad from the coal fields of Manitoba to the international boundary line in the direction of Fort Benton, M. T. Up to the present time Parliament has refused to ratify any railway charter which would admit of a railway being constructed beyond fifty miles north of the international boundary, but now that the Canadian Pacific, whose interests the government was endeavoring to protect, is about completed, it is understood the government will offer no opposition to Mr. Galt's schemes.

**Burlington & Quincy Schemes.**—OMAHA, NEB., Oct. 16.—Articles of incorporation of the Omaha & North Platte have been filed in Lincoln. The capital stock is $5,000,000. The route is west from Omaha about 75 miles thence northwest into Northern Nebraska. This is a Burlington & Quincy scheme, and is intended to head off the Northwestern from building the extension from Fremont to Lincoln. It has not been presented to the board of directors, and it is not known whether they will approve it. The scheme originated with the management of the Burlington & Missouri River, otherwise known as the Nebraska division of the Burlington & Quincy.

**Flood Rock Explosion.**—An interesting calculation of the force of the explosion of the 300,000 pounds of dynamite and rackarack has been made. According to this had the power of the charge at Flood Rock been concentrated, it would have lifted 2,304,000 pounds of dead weight one foot high, and had it been exploded in the open air, it would have undoubtedly killed every person on Manhattan island, as well as for miles around. As it was, the force was expended in pulverizing the rock, and it must have crushed the lower tunnels into pieces as small as marbles. According to the same estimate, 1,284,000 cubic feet of gas were liberated by the explosion.

**Grand Rapids & Indiana Railroad.**—Papers have been filed for the incorporation of a company, to build a branch of the G. R. & I. R. R. to Manistee, Mich. The officers of the G. R. & I Railroad are the officers of the new company, and the capital stock is placed at $450,000 The proposed road extends from Milton Junction, on the line of the G. R. & I. westward to Manistee, a distance of fifty-five miles. The road is already built to Cary, a distance of thirteen miles, will cost about $10,000 a mile to construct it. It is expected work will be commenced immediately and the new line will be in operation by June 1, 1886.

## Recent Patents.

**Car Truck.**—*Edward C. Manning, Washington, D. C.*—Each wheel is on a short independent axle, supported in a frame of four bars, with a transverse central bolster. No. 326, 999.

**Coffer Dam.**—*D. W. Howes, Brooklyn, N. Y.*—A caisson for docking ships, with a series of pivotted arms which are adapted to the shape of the vessel and support the same. No. 326, 985.

**Electric Railway.**—*Henry T. Clay, Philadelphia, Pa.*—A rigid conductor is supported between the rails, in combination with adjustable contact spring brushes, to conduct the current to the motor on the car. No. 327, 381.

**Railway Switch.**—*John B. Batt, Buffalo, N. Y.*—The main, branch, and switch rails are fixed, the wheels being guided by a pivotted frame fitted with guide rails. No. 327, 220.

**Water Elevator.**—*Justus W. Thorp, Dayton, Wash.*—A floating frame carries a water wheel driven by the current; the shaft driving by gearing, an Archimedian screw. No 327, 205.

# Market Report of Engineering Materials.

**New York, October 22, 1885.**

NOTE.—The following Market Report gives wholesale prices on the New York Market unless otherwise stated. It is intended as a general guide to the estimating engineer, and both the range of material and the market location will be extended as rapidly as possible. We give it with this caution, that, as is well understood in business transactions, the amount of bill, distance from market centre and conditions of payment will have a material influence on the final paying prices.

### IRON.

| | | | |
|---|---|---|---|
| STRUCTURAL IRON. | | | |
| Angles | | 2. @ | 2.1 |
| Tee | | 2.2 @ | 2.4c. |
| Beams and channels American | | 3.0c. @ | |
| Tank | | 2. @ | 2.1c |
| Shell | | 2.4c. @ | 2.5c |
| S eel plates, Tank | | 2¼c. @ | 3c. |
| WROUGHT-IRON PIPE.. PITTSBURGH. | | | |
| Butt welded, black | Discount | 42½ @ | 45 |
| " " galvanized | " | 32½ @ | 35 |
| Lap welded black | " | 60 @ | 62½ |
| " Galvanized | " | 45 @ | 42½ |
| Boiler tubes | " | 57½ | |
| RAILS. | | | |
| Steel (large lots at mill) | | 30.00 @ | 31.00 |
| Old rails | | 17.25 @ | 18.50 |
| Old railsteel | | 17.00 @ | 18.00 |
| R R. spikes | | 1.8 @ | 1.9 |
| R R. splice-plates | | 1.65 @ | 1.7. |
| R R. Track Bolts Square Nuts | | 2.55 @ | 2.65 |
| Barb-wire fencing, galvanized | | | 4.50 |
| " " painted | | | 3.50 |
| Corrugated iron | | | |
| Nails | | | |
| Iron | | 2.50 @ | 2.60 |
| Steel | | | 2.15 |

### METALS.

| | | |
|---|---|---|
| COPPER. | | |
| Lake Superior | 11 @ | 11¼ |
| Other Brands | 10¾ @ | 11¼ |
| LEAD. | | |
| Com. Domestic | 4.15 | |
| Lead Pipe | .05¾ | |
| Tin-Lined Lead Pipe | .15 | |
| Sheet Lead | .06¾ | |
| ZINC. | | |
| Sheet | 5.75 @ | 6.00 |

### BRICK.

| | | |
|---|---|---|
| (Cargoes afloat) | | |
| Haverstraw per M. | $5.75 @ | 6.00 |
| Fishkill | | |
| Up-River | 5.25 @ | 5.87½ |
| Jerseys | 4.50 @ | 5.50 |
| Long Island | | |
| " pale | 3.00 @ | 3.50 |
| FRONTS. | | |
| Croton red | 11.00 @ | 14.00 |
| " dark | 11.00 @ | 14.00 |
| " brown | 10.00 @ | 13.00 |
| Philadelphia pressed | 24.00 @ | 25.00 |
| Trenton " | 24.00 @ | 25.00 |
| Baltimore " | 37.00 @ | 41.00 |
| Buff " | 33.00 @ | 35.00 |
| Enameled English | 65.00 @ | 130.00 |
| " American | 85.00 @ | 120.00 |
| Fire brick | 25.00 @ | 40.00 |

### CEMENT.

The following price current is made up entirely from quotations furnished us directly by the firms dealing in each brand; the prices are understood to be wholesale in New York, subject to such special rates as large quantities may warrant:

| | | |
|---|---|---|
| BAETJER & MEYERSTEIN: | | |
| Hanover Portland | $2.60 @ | $2.65 |
| BELLONI & Co.: | | |
| Hemmoor "Crown" brand | | 2.50 |
| JAMES BRAND: | | |
| K. B. & S. | 2.55 @ | 3.00 |
| BROOKS, SHOOBRIDGE & Co., | 2.55 @ | 2.60 |
| HOWARD FLEMING: | | |
| Gibbs' English Portland, 400 lbs. | 2.65 @ | 2.90 |
| K. B. & S. " | 2.75 @ | 2.95 |
| Stettiner, German | 2.65 @ | 2.85 |
| Lugerdorfer, " | 2.45 @ | 2.75 |
| Fleve, A 1, Belgian | 2.35 @ | 2.50 |
| Roman | 2.75 @ | 3.00 |
| Keene's Coarse | 4.75 @ | 5.50 |
| " Fine | 7.75 @ | 8.50 |
| " Superfine | 8.50 @ | 10.00 |
| GABRIEL & SCHALL: | | |
| Vorwohler "Lion" | 2.65 @ | 3.10 |
| HUDSON RIVER CEMENT Co. Rosendale | | 1.10 |
| JOHNSON & WILSON: | | |
| Saylor's American Portland | 2.15 @ | 2.40 |
| LAWRENCE CEMENT Co.: | | |
| Hoffman Rosendale, | | |
| LESLEY & TRINKLE, Philadelphia, Pa.: | | |
| "Giant" Portland | 2.20 @ | 2.40 |
| Improved "Union" | 1.25 @ | 1.50 |
| Union | 1.10 @ | 1.20 |
| MARCIAL & Co.: | | |
| J. B. White & Bros. Coarse | 4.50 @ | 5.00 |
| " Fine | 8.00 @ | 10.00 |
| " Portland | 2.45 @ | 2.85 |
| NEW YORK CEMENT Co.: | | |
| Rosendale | | 1.20 |
| N. Y. & ROSENDALE CEMENT Co.: | | |
| Rosendale "Bridge" brand | | 1.00 |
| SINCLAIR & BABSON: | | |
| Alsen's Portland | 2.45 @ | 2.75 |
| STANDARD CEMENT Co, | | |
| E. THIELE: | | |
| Dyckerhoff | 2.90 @ | 3.25 |
| UNITED STATES CEMENT Co.: | | |
| Windsor | 1.00 @ | 1.10 |
| Standard | | 1.15 |
| Cable's Portland | 2.15 @ | 2.40 |
| UNION AKRON CEMENT Co.: | | |
| Akron "Star" brand, | | |

### ASPHALT.

| | |
|---|---|
| Prices range per ton | $15.00 @ 20.00 |
| According to quantity or brand, and whether taken from vessel or store, | |

### LIME.

| | |
|---|---|
| Rockland common per bbl | 1.00 |
| " finishing | 1.20 |
| State, common | .90 |
| " finishing | 1.10 |
| Kingston, ground | 0.95 |
| Add 25c. to above figures for yard rates. | |

### STONE.

*Cargo rates at New York.*

| | | |
|---|---|---|
| Amherst freestone, No. 1 per cub. ft. | 0.90 @ | 95 |
| " " No. 2 " | 0.75 @ | 0.80 |
| " " light drab " | 0.80 @ | 0.95 |
| Berlin " in rough " | 0.75 @ | 1.00 |
| Berea " " | 0.75 @ | 1.00 |
| Brownstone, Portland, Ct. " | 1.00 @ | 1.30 |
| " Belleville, N. J. " | 0.75 @ | 1.25 |
| Granite, rough | 0.60 @ | 1.25 |
| Common building stone per load | 2.00 @ | 3.00 |
| Base stone, from 2¼ to 6 ft. lengths, per lin. ft. | 0.40 @ | 3.00 |

### SLATE.

| | | |
|---|---|---|
| Purple roofing per square | 6.00 @ | 7.00 |
| Green " | 6.00 @ | 7.00 |
| Red " | 15.00 | |
| Black Penna. (at New York) " | 4.50 @ | 5.00 |

### LUMBER.

Prices for yard delivery in New York.

| | | |
|---|---|---|
| PINE, Common box per M. | 18.00 @ | 20.0 |
| Choice " | 55.00 @ | 80. |
| Tally plank, 1¼ in. 10 in. dres'd. each, | .44 @ | .50 |
| Tally boards, dressed com. " | .28 @ | .30 |
| SPRUCE, Boards dressed " | .25 @ | .28 |
| Plank, 1¼ in " | .28 @ | .30 |
| " 2 in. " | .38 @ | .40 |
| " 2 in. dressed " | .43 @ | .45 |
| Timber per M. | 20.00 @ | 22.00 |
| HEMLOCK, Boards each, | .18 @ | .20 |
| Joist, 2¾ × 4 to 4 × 6 in | .17 @ | .44 |
| OAK per M. | 55.00 @ | 65.00 |
| CYPRESS 1, 1¼, 2 and 2¼ in " | 35.00 @ | 40.00 |
| YELLOW PINE, Girders " | 25.00 @ | 30.00 |
| Dressed flooring " | 28.00 @ | 35.00 |
| SHINGLES, Extra shaved pine, 16 in. " | 5.75 @ | 6.00 |
| " sawed 18 in. " | 2.10 @ | 2.25 |
| LATH, Cargo rate | | |

### PAINT.

| | | |
|---|---|---|
| Lead, white, American dry per lb | .04¾ @ | .05 |
| " " in oil pure " | .05¼ @ | .05¾ |
| English, B. B. in oil | .08¾ @ | .08¾ |
| Red, American | .05¼ @ | .05¾ |
| Litharge " | .05 @ | .05¼ |
| Venetian red, American " | .01 @ | .01¼ |
| Indian red " | .05 @ | .10 |
| Vermillion, American lead " | .11 @ | .11¼ |
| Paris green " | .15 @ | .19 |
| Umber, Amer. raw and powdered per lb. | .01¼ @ | .01¼ |
| Drop black, Amer. " | .08 @ | .12 |
| " " " | .09 @ | .11¾ |
| Chrome green | .05 @ | .15 |
| Oxide zinc, American | .03½ @ | .04 |
| " French | .06¼ @ | .06¾ |